FLIGHT

First Aero Weekly in the World.

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport.

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM.

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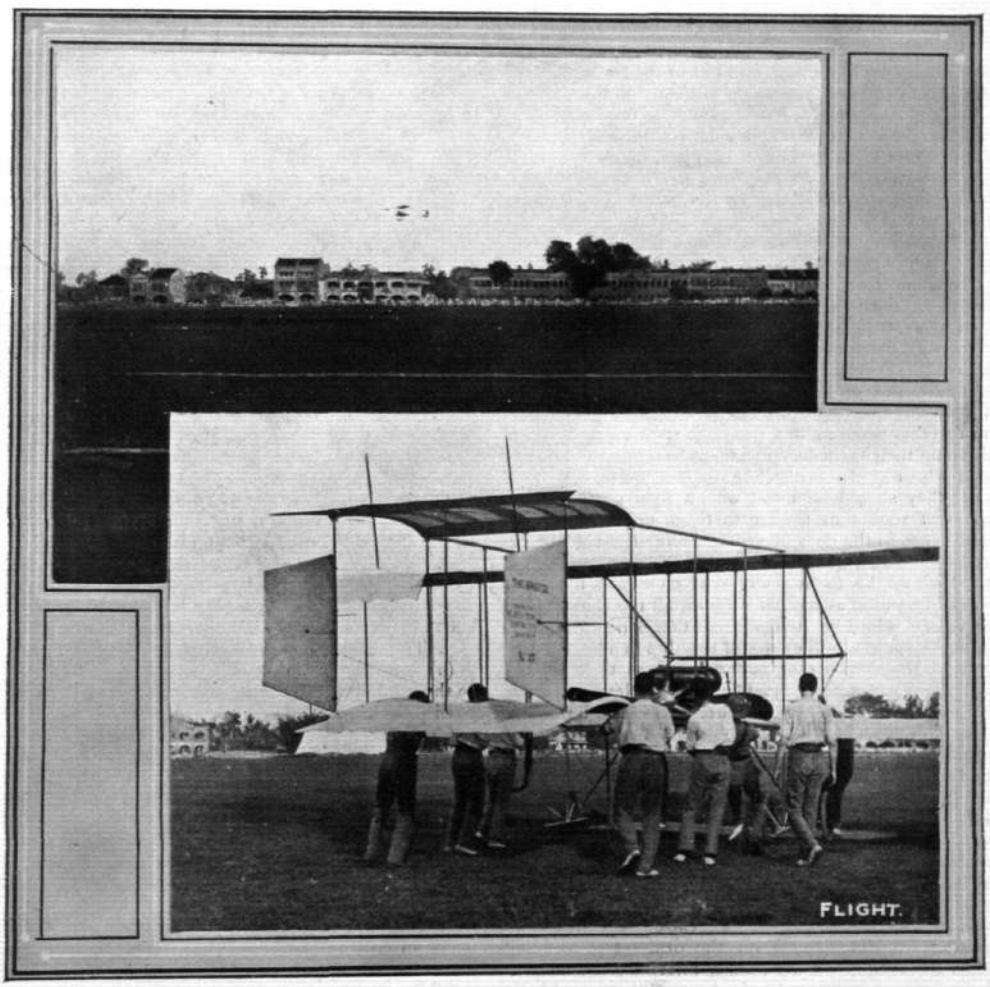


AVIATION IN SINGAPORE.—Scene during the aviation meeting organised there in March. The photographs show Mr. Joseph Christiaens in full flight on a "Bristol" biplane, and below, his machine being wheeled out ready for "taking off."

AEROPLANES IN NAVAL WARFARE.

By FRANK W. B. HAMBLING.

UNDER the above heading in your issue of February 18th an article is printed which to me, and I have no doubt to many others, is so crude that it is impossible to allow it to pass without comment. It is devoted to launching an aeroplane from the deck of a battleship and dropping bombs on the deck of a ship.

Although it is written and translated by Naval men, I am sure that any Commander would look askance at the structures suggested being placed on his decks after they had been cleared for action—they are both unpractical and dangerous, while any bomb-dropping device, the actual usefulness of which is doubtful, makes the whole appear ridiculous, and tends to obscure the great services the aeroplane could and will render in Naval warfare.

In the first place not a word is said of the enemy's aeroplanes or their destruction, which, without doubt, will be the first task, with a note here that aerial supremacy differs vastly from either Naval or Military, in that a fleet of aeroplanes could be built and put in the air in a much shorter space of time than either an Army or Navy could be prepared; always, of course, providing that pilots and factories were available—supremacy and ultimate victory will pass to the nation best equipped in this respect, therefore *during peace the chief aim must be to build and train*—train not only pilots, but the actual constructors of machines.

The aeroplane is, and must always remain, primarily a scout, a destroyer of scouts, communications, means of communication, and undefended vessels, such as submarines, repair ships, merchantmen, &c. Roughly, the aeroplane best suited to this work would be much stronger with greater speed and fuel carrying capacity then those required over land. They must be capable of rising from and resting on the sea, when only moderately calm; and it should also be possible to partly dismantle or put them together when in this position, such as folding or unshipping their main sustainers—to facilitate their being hauled aboard. In preference to any bomb-dropping device, they should be fitted with a light gun, firing a chain shot somewhat similar to those used by the old smooth-bores in the days of sailing battleships; while in place of the structures suggested, a much more practical method would be to fit up one or more fast liners or cruisers to be used as mother-ships for all the aeroplanes. Such vessels would be fitted with all that is necessary for their new vocation. They would push up in line with the outermost Naval scouts, or as far ahead as their speed would allow, with safety; on board would be the Chief Intelligence Officer, to whom all reports would be made by the aeroplane scouts; he would sift the information received before transmitting it by wireless to the head of operations, thus preventing that duplicating of information which is both bewildering and wasteful.

The aerial battle would be fought with these ships as a base, if possible out of sight of the main fleet, the idea being to prevent the exact strength and position of the latter being known. After the destruction of the enemy's aeroplanes the exact position and strength of his fleet could be ascertained by one or two aeroplanes, the remainder being employed on the destruction of the wireless installation on his scouts, afterwards his ships, and, if distance permitted, his base. They would if possible attack his submarines, store and repair ships, but their main object would be to prevent him communicating with his base or any detached portion of his fleet, and also to prevent any new or rebuilt aeroplanes joining hands with him—a task that would leave little time for dropping bombs.

So great, however, would be the advantage obtained, if it were thus possible to render him blind and deaf, that one may say in most cases the aerial battle would decide the final issue.

The details and organisation, however, of our aerial fleet will require much careful thought and prompt action if they are to keep pace with the actual strides the aeroplane is now making.

Accepting these facts, the question at once arises, what are we doing towards perfecting the Naval aeroplane and training pilots to use them? It is a matter for congratulation that the Government are now fully alive to the usefulness of the aeroplane as a scout, and it has been stated that the Army Air Battalion is to act with the fleet, but I would point out that while we retain naval supremacy, it will *not be required to act with the Army*. Therefore as an Englishman I hope it will never be otherwise employed than with the fleet except in an enemy's country. If it is to be of use and not an encumbrance it must have suitable machines. Even our pleasure aeroplanes must, from force of natural conditions, be more seaworthy than those of the Continent. It is therefore useless waiting to see what other nations do; we must in this case strike out for ourselves. In the early days of the movement an offer was made in FLIGHT of a sheet of water to practise over. If this offer had been accepted as whole-heartedly as it was made, and we had reserved our prizes to flights over water, we should now have a machine more suited to our needs, while the second *Daily Mail* Prize might now be going to the best flight round the British Isles, with calls at certain specified ports. However, it is not too late, and much may yet be done in this direction.

What I wish most to emphasise are the following points:—

1. The great advantage of employing the aeroplane as a scout in Naval warfare, when its services are restricted to the sphere of action to which it is best suited.

2. The necessity of developing an aeroplane suitable to our requirements, one capable of acting with and from the fleet without handicapping battleships by requiring such structures as those suggested.

3. The necessity for prompt action in—

(*a*) Organising our aerial forces and training the pilots to the work they would be expected to perform during hostilities.

(*b*) Defining clearly what the actual sphere of the aeroplane is to be, and what type of machine would best suit our requirements.

(*c*) Giving every encouragement and facility both to pilots and constructors.

4. The uselessness of buying Continental machines except for the purpose of adapting them or improving them to suit the very different conditions under which we shall use them.

5. That a good seaworthy or marine aeroplane will make an equally good land one, but we have reason to know that the reverse is not the case.

While it must be pointed out that it would greatly assist the Government and the firms interested if the generous prizes now given were restricted to over-water flights.

FLIGHT PIONEERS.

MR. C. H. PIXTON.

BRITISH NOTES OF THE WEEK.

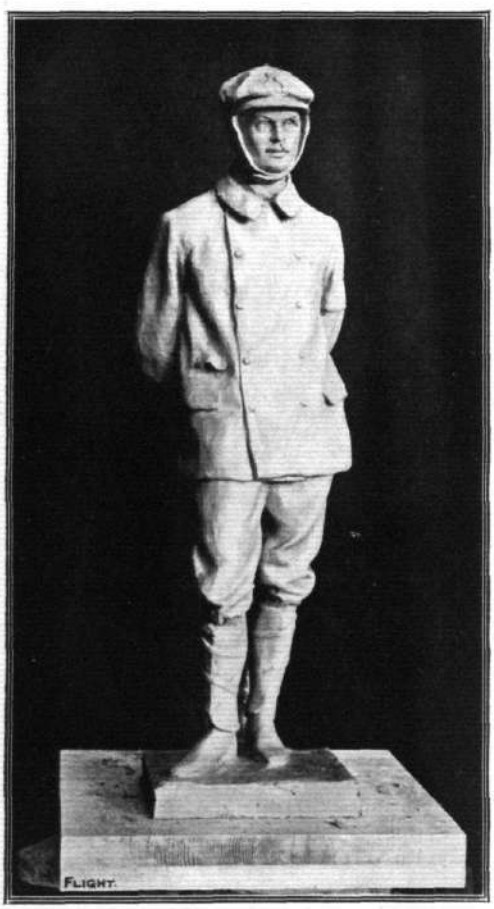
Our Prize Model Scheme.

CONTRIBUTIONS have been received in connection with our Prize Model Scheme from the following :—

L. R. Eyden C. H. Higgins M. B. Ross G. H. Wood
Sidney Faulkner "Redivalls" F. S. Whitbread

Aviation at the Scottish National Exhibition.

AVIATION is well to the fore at the Scottish National Exhibition, which opened at Glasgow on Wednesday last, and visitors should find much to secure their attention in the Pavilion erected for the Scottish Aeronautical Society by Messrs. Speirs and Co. Among actual machines on view are the Pilcher glider used by the late Mr. Percy Pilcher at Cardross many years ago, a monoplane built by Messrs. Mitchell and Sons, another monoplane built by Messrs. W. and S. Pollock, the Grampian monoplane built and engined by Mr. Harold Barnwell, and an Avro triplane. There will also be a comprehensive exhibit of fittings, fabric, and parts, while a great collection of models has been got together by the Scottish Aeronautical Society. FLIGHT is represented by a large number of enlargements of photographs secured at various meetings during the past year, including that at Lanark, and no doubt these will serve as pleasant reminiscences to visitors.



THE LATE HON. C. S. ROLLS.—Plaster model by Lady Scott for the memorial proposed to be erected at Dover to commemorate the late Mr. Rolls' flight from England to France and back. The statue is to be 12 ft. 6 ins. high, and Lady Scott is to be greatly congratulated upon having put into her model the face of the real Charlie Rolls as we all knew him.

Training Staff Officers as Observers.

IN reply to a question, it was stated in the House of Commons last week that the War Office proposes to train Staff Officers as observers, to be carried as passengers in aeroplanes. Such officers will not belong to the Air Battalion.

The Army Aeroplanes.

SOME additional information was given in the House of Commons on Tuesday night by Colonel Seely, Under Secretary for War, when he stated that the total provision in Vote 9 for the manufacture, purchase, and repair of aircraft was £85,300, out of which the purchase or construction of aeroplanes would be provided, but it was premature to say at present to what amount. The additional rate of pay for officers commences on appointment to the Air Battalion after the probationary period. This applies to all officers, whether they have obtained pilot's certificates or not. Asked where the officers obtained their pilot's certificates, and whether they did so at their own cost, Colonel Seely said he could not say off-hand, but he believed they were "the ordinary International certificates."

The Air Battalion.

DURING the early part of this month one of the companies of the Air Battalion will be transferred to Amesbury, in order that the training work of the aeroplane section may be carried out over Salisbury Plain. On April 22nd we published particulars of the establishment of officers of the Air Battalion then announced. The following gives the *personnel* of the Air Battalion at the present time :—Commandant—Maj. Sir Alexander Bannerman, Bart. Experimental Officer—Capt. A. D. Carden. Acting Adjt.—Capt. P. W. L. Broke-Smith. Quartermaster—Hon. Lieut. F. H. Kirby, V.C. No. 1 Company—Lieut. C. M. Waterlow and Lieut. A. G. Fox. No. 2 Company—Lieut. R. A. Cammell and Lieut. H. R. R. Reynolds. Officers attached and graded as Assistant Engineers —Capt. J. D. B. Fulton, Royal Field Artillery ; Capt. C. J. Burke, Royal Irish Regiment ; Capt. H. F. Wood, 9th Lancers ; Capt. E. M. Maitland, Essex Regiment ; Lieut. B. H. Barrington-Kennett, Grenadier Guards ; and Lieut. R. T. Snowden-Smith, Army Service Corps.

Brooklands-Brighton Race Again Postponed.

THE impossible weather on Saturday last was again responsible or the further postponement of the proposed flying race from Brooklands to Brighton. At the time arranged for starting, the wind was blowing at a velocity of about 30 miles an hour, and it gradually increased until 5 o'clock, when a thunderstorm broke over the grounds. Similar conditions prevailed at Brighton, so that it was soon recognised that any prospect of holding the race was out of the question. It was therefore decided, as previously announced, to postpone the event until Wednesday last, with to-day (Saturday) as a further reserve should Wednesday still prove impossible. In order that the large number of visitors to Brooklands should not be disappointed, Mr. Graham Gilmour made a daring flight of two circuits of the track on his Bristol biplane during the afternoon.

British Work at the Russian Exhibition.

THE first International Aeronautical Exhibition to be held in Russia had a very successful opening on the 26th ult., when among a large number of distinguished visitors were the Grand Dukes Alexander and Cyril and the Russian Minister of War, besides many officers of the Russian Navy and Army. The exhibit of British-built Bristol biplanes attracted a good deal of attention, especially in view of the fact that the Russian Army has purchased several of them, and the distinguished visitors complimented Mr. H. White Smith, Secretary of the Company, on the success which has been obtained with Bristol machines. On Saturday the Czar paid a visit to the Exhibition and spent over two hours examining the machines. The Czar also remained a considerable time in conversation with Mr. Kennedy, an English engineer resident in St. Petersburg, who has given prolonged study to the problems of aerial navigation. As we go to press we learn that a Silver Medal has been awarded to the Bristol exhibit.

Flying at Aldershot.

A GOOD deal of flying was seen at Aldershot on Monday, when the Paulhan biplane purchased some time ago by the Government made its first flight with Mr. de Havilland in charge. Mr. Cody was also out on his machine, and indulged in a high flight, climbing up 2,300 feet in 16 minutes. Keeping up to that altitude he flew for about 50 miles, and then dropping down to 800 feet finished with a *vol plané*.

A Scottish Aerodrome.

A LARGE tract of land adjoining the Cowan public park at Barrhead has, it is announced, been leased to Mr. W. S. Duncan and two other members of the Scottish Aeronautical Society for the purpose of making an aerodrome. It is intended to establish a school there and to organise flying meetings, one of the first of which is to be on Coronation Day, when the Cowan park, which has just been laid out, will be thrown open to the public.

Mr. Radley back at Huntingdon.

LAST week Mr. Radley's Blériot monoplane, which it will be remembered was the first to fly at Huntingdon, made a welcome reappearance at the Portholme Aerodrome. It is at present housed in a new shed near the Great Northern Railway, and as soon as the weather improves Mr. Radley hopes to indulge in some lengthy practice in view of his entry for the *Daily Mail* prize. Important developments are likely at Huntingdon in the immediate future.

School Aero Clubs.

CONTINUING his work of furthering the movement for the oundation of School Aero Clubs, we notice that Mr. R. P. Grimmer has contributed a very instructive article to the May numbers of *The Cap'ain* and *The Boys' Own Paper*. In both cases the articles are well illustrated, and should do a great deal to further interest the young idea, and lead them to take up the subject of model aeroplanes in a serious manner.

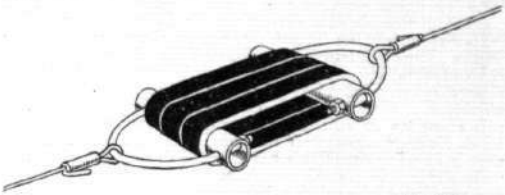
Hangars for War Office Aeroplanes.

MESSRS. W. HARBROW, whose works adjoin South Bermondsey Station, S.E., have been for years contractors to one or other Department of the Government. It is therefore indicative of the careful and satisfactory manner in which they carry out their work that the contract for the erection of the hangars required to house the Government aeroplanes at Durrington Down, Salisbury Plain, should have been placed in their hands by the War Office. The buildings are now in course of completion.

New Clubs in S.W. and N. London.

A MODEL aero club is being formed for the Hurlingham and Fulham district and those desirous of joining should communicate with Mr. M. Barry, 194c, New King's Road, Hurlingham, S.W. A well-known English aviator has promised to do all he can to help the club as soon as it is properly formed.

Another club is being formed in North London and those who are interested in this proposal should write to Mr. W. Wentker, 55, Maryland Road, Bowes Park, N.



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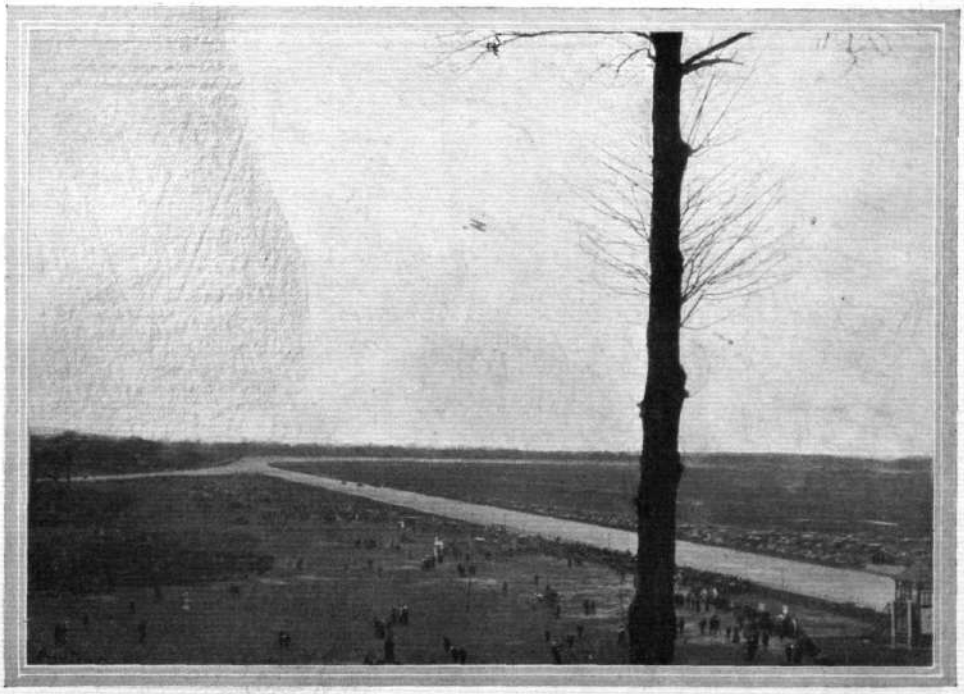
Sketch of the Clarke type rubber shock-absorber, which can be used for a variety of purposes.

Booking Passengers in Paris.

FOLLOWING the success which has attended the opening of a box-office for the sale of tickets for passenger flights in London, the *Daily Mail* Information Bureau in Paris has now made arrangements for the booking of passenger flights to be made either at Issy or at Etampes. The prices range from £2 for a single circuit of the Issy Aerodrome to £16 for half-an-hour's flight at Etampes, while town-to-town flights can be arranged at the rate of 8*s*. 6*d*. per mile. The first passenger at Issy was Mr. Tom Hearne, the English comedian, who took a £4 ticket and went four times round the ground.



CARS AND AEROPLANES AT BROOKLANDS.—Pixton on the Roe biplane during the duration flight at Brooklands on Easter Monday. Below will be noted a race finishing up the straight, with the crowds in the enclosures, and the long wide string of motor cars stretching away beyond the paddock.

FROM THE BRITISH FLYING GROUNDS.

Royal Aero Club Flying Ground, Eastchurch.

SINCE the advent of the naval officers at Eastchurch, training for their certificates, increasingly active work has been evident.

After the brief spell of June weather last week, which enabled Lieut. Samson, R.N., and Lieut. Longmore, R.N., to gain their pilot certificates, the atmospheric conditions speedily relapsed to their old bad habits, so that it was impossible to get in more than a few hours' flying during the week.

On Saturday, the 29th ult., it was blowing strongly from the S.W. all day, with the sky generally covered with threatening rain-clouds. Towards evening, however, a distinct improvement began to assert itself, and it was hoped that it would become settled enough to allow Lieuts. Gregory and Gerrard to pass the tests for their pilot certificates. About 6 p.m., Mr. Cockburn went up just for a trial spin round the ground, and he having reported everything safe, Lieut. Gregory mounted the machine for his pilot run. Rising quickly into the air, after a run of some 20 yards only, he flew quite steadily, having the machine under perfect control, and making the first figure of eight lap in good curves. At this point, however, the wind freshened considerably, the event being signalled by the sharp cracking of the flag which marked the position of the official observers. The wind had sprung up with surprising suddenness, bringing with it dark stormy rain-clouds, and it was quite clear that a squall was approaching. Although the aviator was, of course, feeling the effect of the changed conditions, it was evident he had not the slightest intention of coming down before he had completed the regulation course. The result was a really splendid flight, made under difficult conditions, and it was all the more surprising considering that Lieut. Gregory had not been in the air more than three times previously. When he finally landed he had duly qualified for the first half of his pilot certificate, but further flying was out of the question, as by this time it was blowing half-a-gale, much to the disgust of the two aviators chiefly concerned. Several flights were made on Sunday evening about 7 p.m., the Hon. Maurice Egerton making three cross-country flights, each of about 20 mins. duration.

At 5 a.m. on Monday the inhabitants of Eastchurch were awakened by the musical hum of a Gnome motor overhead. It proved to be Egerton returning from a cross-country flight on his new Short (No. 35) biplane. During the trip he had made the circuit of the island, passing in his course Leysdown, Harty, Queenborough, and Sheerness, and finally out nearer to Sittingbourne, the flight lasting 1 hr. 25 mins.

At the same time Lieuts. Gregory and Gerrard were in the air, both qualifying for their pilot certificates with skilful flights.

All the four naval officers nominated by the Admiralty have now taken their certificates under the new rules, after having averaged only three flights each, a fact which hardly requires comment in respect of Mr. Cockburn's tutelage and the capabilities of the Short biplanes, on which all the flights have been made. If emphasis were wanted of the remarkable, not to say natural, aptitude of the naval man as an aviator, it is surely forthcoming in the rapid acquirement of the art by these officers following so quickly upon that of Lieut. Parkes at Brooklands the previous week.

Brooklands Aerodrome.

TUESDAY, Wednesday, Thursday and Friday last week were all impossible days, owing to the high wind.

On Saturday a large crowd arrived to witness the start for the race to Brighton, but the weather was far from good, so the race had to be put off. Mr. Gilmour, however, took out the Bristol, and made a very fine flight in the height of the wind. Mr. Hamel later made a short flight on his Blériot, then had to descend owing to his engine overheating. He found on examination that the oil service had got out of order.

Sunday was a perfect flying day. Aviators are early risers, and work started at 4.30 a.m., Mr. Fisher being the first to take the air on the Hanriot. He and Mr. Oxley were flying off and on till 6.30 a.m. Mr. C. Jenkins was also out on the Roe biplane, and rose to over 1,500 ft., this being a very fine performance for a beginner. He demonstrated his complete mastery of the machine by steep *vol planés*, and sharp turns both to right and left. Mr. Kemp also made some figure eights on the same machine. Lieut. Snowden-Smith then rose to a great height on his racing Farman, and descended with a very fine spiral *vol plané*. His engine had completely stopped when he reached the ground. Capt. Sykes then made a few flights on the Bristol, making several right-

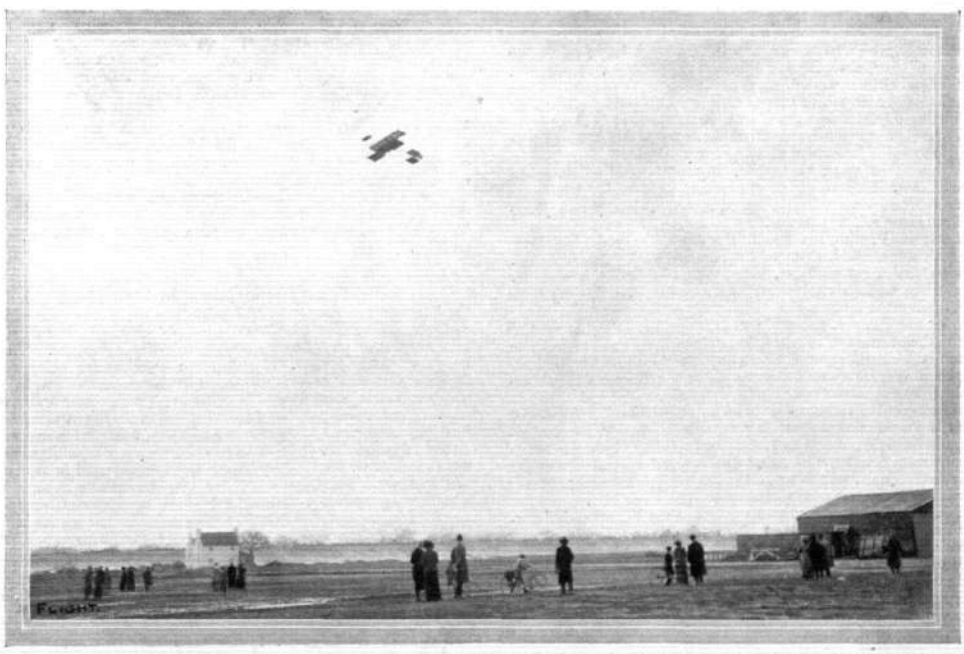
Mr. F. Conway Jenkins, one of the latest aviators to qualify for the Royal Aero Club pilot's certificate, on the 30-h.p. Green-engined Avro biplane, upon which he passed the tests on the 30th ult. in a 12–15 m.p.h. wind. This was only Mr. Jenkins' fourth time on the Avro machine, and previous to the official tests he was in the air at Brooklands for forty minutes at about 1,000 ft. height, rising to about 1,800 and finishing with a neat *vol plane*.

hand turns. During all this time Fisher and Oxley had been flying turn and turn about. Mr. Fisher shows great skill in handling the Hanriot. His are the smallest figure 8's ever seen at Brooklands; the Clerget engine appears to be a masterpiece, and one can only liken it to the Gnome. It runs as an engine should run and has great power for its size. The wind rose after 6.30 a.m. and the first out was Mr. Gilmour on the Bristol. Mr. Jenkins then started out to win his certificate, which he did in fine style, flying at an average height of 500 feet. Mr. Blackburn was next out on the Bristol, he also flying for his ticket. He was quickly followed by Mr. Oxley on the Hanriot. These two carried out some very pretty flying together. Mr. Oxley retired after making his first flight as he said that it was rather trying to be flying with another over the same course. Mr. Blackburn continued and made his second flight, which was finished in a heavy rainstorm. As soon as the rain was over Mr. Oxley made his second flight. Capt. Sykes on the Bristol then set out to secure his certificate. He was rapidly followed by Mr. Fisher on the Hanriot, who was out for the same purpose.

M. Prier, with Mrs. Gordon Jones, a pupil at the Blériot School of Aviation at Hendon, in the passenger seat, just about to get away for a flight.

There were at this time six machines in the air, manned by Messrs. Snowden-Smith, Ducrocq, Watkins, Fisher, Sykes and Gilmour. The most thrilling incident ever witnessed at Brooklands took place while Fisher and Sykes were flying. They were both making the right-hand turn, and Fisher, the inside man, was rapidly overtaking Capt. Sykes as the Hanriot is a good 20 m.p.h. faster than the Bristol. The two machines were seen to be rapidly approaching each other, and it looked as though there was going to be a collision, the planes actually overlapping each other, the saving clause, luckily, being that Fisher was a few feet above Sykes. On landing, Fisher and Sykes were congratulated upon their wonderful escape, and they both expressed ignorance of the fact that they had ever been near each other! Mr. Fisher rested for a few minutes, but Capt. Sykes decided to go for his second flight. In landing he damaged his machine, breaking his elevator and right-hand planes. The accident was due to misjudging his landing. Mr. Pixton's was the star performance. He rose to quite 3,000 ft. on the Roe biplane, and came down with a long spiral *vol plané*, after gliding for about two miles from over Byfleet Station. Mr. Morison was out on the Bristol and made several solo and passenger flights.

This was a record day for Brooklands. Five men passed for their certificates—one from the Roe school, two from the Hanriot school, and two from the Bristol. Fisher, on the Hanriot, pleased the public greatly with his very graceful flying, some of his corners being worthy of a Latham, he often letting the machine bank to over 30°. On Monday morning M. Pecquet was out on the Humber biplane, and covered several circuits. Mr. Pixton and Kemp were at work on the Roe biplane.



Mr. Graham Gilmour giving an exhibition flight at Brooklands on the Bristol biplane last Saturday by way of gratifying the disappointed visitors who had foregathered to witness the start for the Brighton flight. At the time a very high wind, amounting almost to a gale, was blowing.

Filey School.

LIKE the rest of the country, work here has been greatly restricted by the inclement weather. On Friday last week Mr. Hucks took out one of the school machines of the Blackburn "Mercury" type, on which he made seven flights of several miles each. On the last occasion he met with an unfortunate though very peculiar accident. In heading towards Speeton Cliffs, the ground, which was new to him and which requires some careful negotiating, in skimming along the apparently shallow water, Mr. Hucks believed himself to be flying over the wet sand. At this point he attempted to land on what he thought was substantial ground which, however, proved to be one of the many large pools among these shallow waters, with a higher sand ridge on the further side. On this ridge the skids of the landing chassis struck, throwing the machine from its horizontal position into a vertical one, so that when the revolving propeller struck the water a spray was raised to such a height that it was seen at a very considerable distance off, and the machine was left standing on its end until eventually pulled down. Mr. Hucks was thrown from his seat, but escaped with but a few bruises received by contact with some of the stay wires.

Beyond the propeller being broken, no damage was done to the machine, the landing chassis and main planes being unscathed. The propeller was immediately replaced, and the engine thoroughly cleaned to rid it of sand, and the machine was again ready for the air on Monday.

A Blériot type machine, manufactured by the Blackburn Aeroplane Co., and recently sold to Mr. R. J. Weiss, of Dewsbury, has arrived, from the Leeds works, at the school, where Mr. Weiss is taking his tuition in flying, and intends using the machine for some me.

Liverpool Aviation School, Sandheys Avenue, Waterloo.

AFTER a long period of inaction owing to the boisterous weather, the above school, of which Mr. Henry G. Melly is the Principal, has begun this week busily, first by the arrival of a new pupil, Mr. A. Dukinfield-Jones, who at once proceeded to take his first lesson on the Blériot-Anzani, getting accustomed to the engine controls with the machine anchored. Later on the new Blériot two-seater (Gnome engine) arrived, and was immediately unpacked preparatory to getting the wings and propeller fitted. It is hoped she will be ready during the present week to be put through her paces, followed by regular tuition work.

London Aerodrome, Collindale Avenue, Hendon.

Blériot School.—Tuesday morning of last week being calm, two of the school machines were brought out and Messrs. Henderson, Champion and Salmet were fortunate in being able to put in some air work, as at about 9 a.m. the wind got up, stopping all further flying for that day. This state of things continued until Saturday.

On Sunday morning Messrs. Champion and Dyott managed to get a little practice before the wind sprang up again.

A good deal of work was done, however, on Monday, when Messrs. Salmet, Henderson and Champion were making left and right-hand turns, while Messrs. Dyott, Seamon, Psalty and Jones indulged in some rolling practice.

Lieut. Cammell, who has bought the fine military double-seater Blériot which was exhibited at Olympia, arrived during the afternoon, and after a trial flight with Mr. Prier, took charge of the machine. He first made a wide circle over the aerodrome, going up very rapidly, and after attaining a height of about 1,000 ft., made straight for the Thames, rising higher all the time. Passing west of Ealing he then turned in the direction of Brooklands and from there continued on to Farnborough, where he arrived quite safely, thereby scoring up a very fine cross-country flight for British officers, his speed being at the rate of over a mile a minute.

Grahame-White School.—It was not until Sunday afternoon last that a machine could safely be brought outside its hangar, and even then the wind was so boisterous that only Grahame-White ventured out on his Baby biplane. He covered several circuits at an altitude of 150 ft., and one could see that a good amount of lever work was necessary to keep the machine on an even keel.

On Monday morning operations commenced at an early hour. Greswell was the first of the school to take the air, flying the old "Blue Bird" school Blériot, which was afterwards handed over to Ridley-Prentice. At his first attempt he succeeded in steering a straight course, and making straight line flights the whole length of the ground. Evidently experience on a biplane is a valuable asset when learning a monoplane. Meanwhile Greswell had brought out the 40-h.p. E.N.V. Blériot, and made a good flight of 20 mins. duration. On descending he mounted the school Farman, and gave instruction to the several pupils by taking them up as passengers. After another flight on the E.N.V. Blériot the wind freshened and tuition operations had to be temporarily suspended. Later on in the afternoon the wind dropped, and Travers went out on the school Farman, making a good flight of three circuits—this being his first attempt at a turn.

Mr. Compton Paterson then made a long trip on the Farman biplane on which Mr. Grahame-White flew to Birmingham, taking up with him a passenger, Mr. Davis, a new pupil. Shortly afterwards he carried Captain Higgins, who is also a new arrival at the school.

A feature of the evening's flying was Clement Greswell's exhibition on the school Gnome-Blériot. Climbing rapidly until an elevation of 2,000 ft. was reached, he set off in the same direction as Lieut. Cammell, who was flying his newly-acquired two-seater Blériot to its future headquarters at Farnborough.

Doubling back on reaching the "Welsh Harp" waters he passed over Hendon at fully 2,500 ft. and returned to the aerodrome.

His *vol plané*, which must have lasted fully 3 minutes, was of the spectacular spiral variety, and exceedingly well accomplished. While Greswell was absent from the aerodrome, Martin was giving a thoroughly good exhibition on the Grahame-White Baby biplane, flying several circuits and showing off effectively the inherent speed of this miniature biplane.

Words are not equal to describing the awful weather that prevailed on Tuesday. Of course, no flying could be undertaken.

Valkyrie School.—The weather looking favourable on Tuesday of last week a number of pupils assembled for instruction. They were, however, doomed to disappointment, for the school instructor taking out "Valkyrie IV" and making several flights round the aerodrome, deemed the weather altogether too rough for novices. This state of things continued all the rest of the week, and practically no flying could be indulged in until Monday, May 1st. Determined not to lose any time then, the Valkyrie School started work at about 5 a.m., and was hard at it until the wind rose at about 8 o'clock. Miss Meeze took her first lesson and got on very well indeed, and she should begin making short flights with very little more practice. Mr. Perry, of the Army Balloon Factory, also had his first lesson and showed good promise. The Valkyrie pilot had several of the machines out and made a number of excellent demonstrations. Mr. Louis Turner was given a passenger flight. During the day Miss Meeze put in some more rolling practice, and later, the wind having somewhat abated, Mr. Chambers took the school machine in hand and made several straight flights. Mr. Turner also indulged in some practice on the school machine.

The day finished with several very fine flights on the part of the Valkyrie designer, who used the latest "Type A" machine. Quickly ascending to a considerable height, he circled round and round the aerodrome with great steadiness, executing very steady *vol planés* each time he passed the hangars.

If the clerk of the weather during the next few days will only prove sufficiently gracious, it is hoped to test the new Gnome-engined Valkyrie racer, which is designed for a speed of from 60 to 70 miles an hour.

Salisbury Plain.

STRONG and persistent winds rendered flying impossible during the latter part of last week, and work was therefore confined to the hangars, where the time was spent in erecting machines, and instructing the pupils in the proper care of engines, &c. The new hangars which Messrs. Harbrow are erecting are being pushed forward, and will be ready for occupation very shortly now, while another shed is being altered in order to obtain greater accommodation. Sunday was the first day fit for flying, and then Grandseigne brought out the new racing Bristol biplane, and did some rolling. In the afternoon M. Jullerot was in the air on the military biplane with extensions, but lengthy flying was not indulged in as the wind was somewhat treacherous. There was a welcome change in the weather on Monday, and school work commenced very early, M. Jullerot being first at work, taking Mr. Turner up for a flight, while Mr. Pizzy shortly after followed suit with other pupils. During the afternoon Mr. Graham Gilmour arrived at the hangars, but by that time the wind had sprung up again, and put an end to flying. On Tuesday also the weather was against flying there being too much wind.

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Flying in Japan.

A FEW details are just to hand from a correspondent regarding the flying which took place in Japan during the early part of last month. On the 3rd ult. Mr. Mars, the American aviator, commenced a series of flights on a Curtiss biplane at the race-course at Meguro. About 3,000 people were present, including Major-General Tokunoga, who is in charge of military aviation in Japan. Unfortunately the demonstration flights had to be cut short owing to the very heavy rain, and on the following day Mr. Mars had an accident, the machine falling and damaging the elevator. The damage was not, however, very serious, and on the 5th he made two short flights.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

Committee Meeting.

A MEETING of the Committee was held on Tuesday, the 2nd inst., when there were present :—Mr. R. W. Wallace, K.C., in the chair, Mr. Griffith Brewer, Mr. Ernest C. Bucknall, Capt Bertram Dickson, Prof. A. K. Huntington, Mr. J. T. C. Moore-Brabazon, Mr. Mervyn O'Gorman, Mr. C. F. Pollock, and Harold E. Perrin, Secretary.

New Members.—The following new members were elected :—Henry F. Atkinson-Clark, Montague Churchill-Shann, Gerald Higginbotham, George Armitstead Scott, Francis Sydney Shaw, Capt. Frederick Hugh Sykes, and James Walton.

Aviators' Certificates.—The following Aviators' Certificates were granted :—

74. F. Conway Jenkins.
75. Lieut. Reginald Gregory, R.N.
76. Lieut. Eugene L. Gerrard, R.M.L.I.
77. E. V. B. Fisher.

Flights for Certificates.—In connection with the flights undertaken by aviators for their certificates, a danger has arisen from the fact that the new conditions entail both right-hand and left-hand turns, thus causing confusion in cases where aviators, other than the candidate, are flying at the same time. To meet this difficulty, the Committee of the Royal Aero Club has decided to issue a special instruction to observers that flights for certificates are only to be carried out when the course is clear.

Gordon-Bennett Aviation Race.

The entries for British aviators closed on Monday last, the 1st May, at 12 noon.

The following entries have been received :—H. Blackburn, D. Graham Gilmour, C. Grahame-White, C. H. Greswell, G. Hamel, O. C. Morison, Alec Ogilvie, James Radley, T. O. M. Sopwith, and James Valentine. The Committee of the Royal Aero Club will select from this list the three representatives of Great Britain.

The race will take place on Saturday, July 1st next, and the venue will be announced shortly.

The following countries, each represented by three competitors, will take part in the contest :—America, Austria, France, Germany, and Great Britain.

Sub-Committees.—The following Sub-Committees have been appointed :—

Technical Committee.—A. E. Berriman, Griffith Brewer, Col. J. E. Capper, C.B., R.E., G. B. Cockburn, Com. F. Creagh-Osborne, R.N., Col. H. C. L. Holden, R.A., F.R.S., Prof. A. K. Huntington, Major F. Lindsay Lloyd, J. T. C. Moore-Brabazon, Alec Ogilvie, and Mervyn O'Gorman.

Club Flying Ground Committee.—Ernest C. Bucknall, Hon. Maurice Egerton, Prof. A. K. Huntington, F. K. McClean, and J. T. C. Moore-Brabazon.

Library Committee.—A. E. Berriman, C. G. Grey, T. O'B. Hubbard, Prof. A. K. Huntington, V. Ker-Seymer, Sir David Salomons, Bart., and Stanley Spooner.

Demonstration at Hendon Aerodrome.

The privilege of free admission kindly accorded to members of the Club by the proprietors of the Aerodrome will be suspended on Friday next, May 12th, when a private demonstration will be given before the members of the Parliamentary Aerial Defence Committee, the War Office, and members of the House of Lords and House of Commons.

The Parliamentary Aerial Defence Committee has kindly promised to issue a few invitation cards for this function to members of the Club. Members, therefore, desiring tickets, are requested to make written application to the Secretary, Royal Aero Club, not later than Wednesday next, May 10th.

Naval Officers at Eastchurch.

The four Naval Officers, viz., Lieuts. Gerrard, Gregory, Longmore and Samson, who have been undergoing a course of instruction in flying at the Club's flying grounds at Eastchurch, under the guidance of Mr. G. B. Cockburn, have all succeeded in obtaining their aviators' certificates in accordance with the new rules. The aeroplanes used were placed at the disposal of the Admiralty by Mr. Frank McClean.

Army and Navy Aviation Prizes.

(*Presented by Mr. A. Mortimer Singer.*)

Lieut. Wilfred Parke, R.N., has sent in his entry for the above prizes.

The rules can be obtained from the Royal Aero Club.

Manville £500 Prize.

The next date for this competition is Saturday, May 6th. Entries have been received as follows :—1. S. F. Cody; 2. H. Barber; 3. A. Ogilvie.

Rules can be obtained from the Royal Aero Club.

"Daily Mail" Second £10,000 Prize.

Entries for this Competition close at 12 noon on June 1st, 1911. The entrance fee is £100, payable in one sum or as follows :—

£25 by 12 noon on June 1st; £75 by 12 noon on July 1st.

Late entries will be received up to 12 noon, July 1st, 1911, in which case the entry fee will be £200.

Copies of the rules and entry form can be obtained from the Secretary, Royal Aero Club, 166, Piccadilly, London, W.

HAROLD E. PERRIN,
166, Piccadilly. Secretary.

PROGRESS OF FLIGHT ABOUT THE COUNTRY.

NOTE.—Addresses, temporary or permanent, follow in each case the names of the clubs, where communications of our readers can be addressed direct to the Secretary. We would ask Club Secretaries in future to see that the notes regarding their Clubs reach the Editor of FLIGHT, 44, St. Martin's Lane, London, W.C., by first post Tuesday at latest.

Conisborough and District Model Ae. Soc. (18, CHURCH ST.).

ON Monday, April 24th, T. S. Wallis made the winning flight of 405 ft. for the April competition. The competition during the month was very keen, many good flights being made. The result was as follows :—1st, T. S. Wallis, 405 ft.; 2nd, F. J. Wright, 370 ft.; 3rd, C. C. Allport, 318 ft.

Coventry Aeroplane Building Society (22, KINGSTON ROAD).

A COMPETITION for models will be held on Hearsall Common on Saturday, May 6th, at 3 o'clock. Prizes will be awarded for distance flown, duration in the air and direction of flight.

A competition is now open for members to submit designs for the club's full-sized glider. Designs must be sent in by August 1st.

Kite and Model Aeroplane Assoc. (27, VICTORY RD., WIMBLEDON)

A VERY instructive paper upon "The Work of the School Aero Club" was read on April 27th by Mr. R. P. Grimmer, the well-known hon. sec. of Arundel House School Club, Surbiton. He gave a detailed description of the history, organisation, and experiences of the school club since its foundation in 1908, and it is pleasing to note how well the boys have worked to bring this club to the front by their untiring patience. He also appealed to the public schools to form aero clubs, and showed what boys could do for aviation.

The president, Major Baden-Powell, presided, and at the close of the lecture proposed a vote of thanks to the lecturer for his paper, and for the able way in which he had put the question of school clubs before the members, and said he hoped that the club would continue to meet with the success it deserved.

SCHOOL AERO CLUB.

Arundel House School Ae.C. (15, ARLINGTON ROAD, SURBITON).

DURING the week further trials have been carried out with the Mann monoplanes, No. 31 again accomplishing durations of 60-70 seconds. The new model, No. 32, which is designed to rise from the ground under its own power, and fly at a speed of 5 m.p.h., proves to be a great success, and it will be in evidence at the summer competitions for machines of that class.

The first prize in the Drawing Competition open to club members has just been awarded to Roy Lucas, his contribution being an excellent sketch of a Farman biplane in full flight at Brooklands.

ADDITIONS TO OUR LIBRARY.

"THE AEROPLANE, PAST, PRESENT AND FUTURE." By Claude Grahame-White and Harry Harper. Published by T. Werner Laurie at 15*s*.

It is to be hoped that Mr. Harry Harper will obtain the reward that he deserves for the painstaking way in which he has compiled the book that has been issued by Mr. Claude Grahame-White and himself. It is a singularly interesting collection of chapters, all the more so because most of them have been written by different authors. Mr. Claude Grahame-White himself contributes a brief section on the fascination of flying. Mr. C. G. Grunhold provides a most attractive series of word pictures describing his recollections of early historical flights, and among other writers are Colonel Capper, M. Louis Paulhan, M. Louis Blériot, and Messrs. Howard T. Wright, Henry Farman, Roger Wallace, G. Holt Thomas, C. G. Grey, Mervyn O'Gorman, S. F. Cody, and F. K. McClean.

It is, as we have said, an interesting collection of authors and individual preference of readers for any particular section will doubtless vary widely. For our own part we have found nothing that is better reading than the views of the late Mr. Cecil S. Grace as put into writing by Mr. Harry Harper following a conversation that took place between them in the Lord Warden Hotel at Dover just before the fatal journey. It is impossible to resist a feeling of sadness in recalling the name of one who showed so much promise, and, indeed, if the book in which his last remarks have thus been so fittingly made public has a fault at all, it is the somewhat unfortunate prominence that has been given to the chapter of death. Mr. Harper has meant well in reviewing aeroplane fatalities in the light of such evidence as may exist for the purpose of guiding others in avoiding the faults of those who have gone before. The author has done his work well, too, but the unpleasant fact still remains that there are fifty pages or so all about accidents, and that little paragraph introducing this section, which says so strikingly that "from February 17th, 1908, to February 9th, 1911, during slightly more than two years of entirely experimental work, there have been thirty-four aeroplane fatalities." During this period appreciably more than 1,000 men have learned to fly, is apt to be forgotten by the time one has arrived at the thirty-fourth.

For the rest the book should contain something to attract and please all interested in flight. It is particularly well illustrated and is a work that should be bought and read at once.

"ENCYCLOPÆDIA BRITANNICA." Eleventh Edition. Aeronautics and Flight. Published by Cambridge University Press.

A very great deal has already been published throughout the general Press about this latest edition of the "Encyclopædia Britannica," with its india paper and flexible leather binding, but as yet little has been said concerning the contents of this stupendous work, and, after all said and done, india paper and leather covers are no commensurate return in themselves for an outlay that runs into something between twenty and forty sovereigns according to quality of paper and of binding. It is, of course, impossible for any one person to give anything like a comprehensive idea of the utility of so vast a work of reference, which is about the best of its kind that has ever been produced, so it is with all the greater willingness that we comply with the Editor's request and confine our attentions to the sections devoted to Aeronautics and Flight, in which we have a particular interest.

To confess that we are disappointed with the articles in question is to express but mildly our astonishment at the inadequate treatment these two subjects have received. In no encyclopædia, of course, can aeronautics and flight, taken separately, very well make more than two sections out of many thousands; but that valuation seems precisely to sum up the full significance of the most epoch-making development of modern times in the eyes of the Editor of the eleventh edition of the "Encyclopædia Britannica." When J. W. L. Glaisher contributed his article on aeronautics to the ninth edition of this work, which was published in 1875–1889, and when J. Bell Pettigrew wrote for the "Encyclopædia Britannica" an article dealing with the science of flight, the navigation of the air was in an utterly different state to what it is to-day. And yet, forsooth, the Editor of this supposedly up-to-date eleventh edition, in his note on this particular subject, says that "So far as aerial transport is a reality, it is discussed in 'Aeronautics' and 'Flight and Flying,'" while he adds: "The former deals with balloons and dirigibles and is based, with additions, on the article by J. W. L. Glaisher in the ninth edition. The latter deals with the problems of flight (the late Prof. J. Bell Pettigrew) with additions covering the modern development of machines heavier than air (aeroplane)."

Well, so far as aerial transport *is* a reality, all we can say is that the eleventh edition of the "Encyclopædia Britannica" does it a singular injustice. Glaisher and Pettigrew were most able men in their time, and the author who re-arranged their articles "with additions" learned, let us hope, something in the process. It is all very interesting of its kind, too, only unfortunately most of it has been thoroughly done to death by every man who has ever put pen to paper in the interests of the subject, and who has resorted to the public library and to its encyclopædia for inspiration. Even as an effort at sub-editing it is open to criticism, for among the gems is one to the effect that "the reader has only to imagine Figs. 8 and 9 cut out in paper to realise that extensive inert horizontal aeroplanes in a flying machine would be a mistake." And, in order to avoid misunderstanding, a footnote explains "by the term aeroplane is meant a thin, light, and expanded structure, inclined at a slight upward angle to the horizon, intended to float or rest upon the air and calculated to afford a certain amount of support to any body attached to it."

"Calculated to afford a certain amount of support" is rather delightful when one comes to imagine the timid passenger of to-day invited to experience a flight in one of these "mistaken" machines inquiring if the calculated support will be enough for two. But, joking apart, it is seriously to be deplored that such an article should appear at the present time in such a professedly reliable compilation as the eleventh edition of the "Encyclopædia Britannica," which has received the additional distinction of being issued under the ægis of the University of Cambridge.

As to the so-called "additions" these comprise mostly a few half-page photographs of aeroplanes and dirigibles in flight. The text of the article on "Aeronautics" manages to take things up to the year 1908, when the Zeppelin was burned at Echterdingen. In the "Flight and Flying" article success has been achieved in squeezing in an extra year, but in any case the period from Lilienthal onwards occupies about two pages out of about sixteen—and this in view of all that has been learnt and done since the Wright Brothers came over to Europe.

"BIRD FLIGHT AS THE BASIS OF AVIATION." By Otto Lilienthal. Translated from the second edition by A. W. Isenthal, and published by Longmans Green at 9*s*.

The practical art of flying was born when Otto Lilienthal conceived the idea of gliding. This he did as the result of his observations of birds, for having watched bird flight he saw very clearly that notwithstanding their obvious muscular exertion at times, much of the aerial navigation that they accomplish is obtained without the expenditure of their own energy. Otto Lilienthal was born in Pomerania in 1848, and developed an interest in flight at the early age of thirteen, his initial experiments being carried out at school with the aid of his brother Gustavus. After the Franco-Prussian War of 1870, Otto Lilienthal resumed his researches in the light of a more matured mind, and realising that his past failures were largely due to an incomplete study of first principles, he set himself the task of scientifically observing the anatomy and behaviour of birds. In 1889 he published his first pamphlet, under the title of "Bird Flight as the Basis of Aviation," and it is the second edition of this work that has at last been rendered into English. Those in England who respect with more than superficial regard the labours of the fathers of aviation will hurry to secure this useful memento of one whom many consider, with some reason, to be the greatest of all pioneers. But, apart from these, the sterling merit of the book itself will attract many other readers now that it has been so ably translated; a ready distribution of the present edition should result.

"THE GYROSCOPE." By V. E. Johnson, M.A. Published by E. and F. N. Spon, at 3*s*. 6*d*.

So much has been said about gyroscopic control of aeroplanes and the gyroscopic force of rotary motors that it behoves every student of flight to be really familiar with the gyroscope itself. There is no better way of doing this than by purchasing a gyroscopic top, which may be bought for 1*s*., but on which the sum of 10*s*. or more may be spent with advantage. Having obtained the top, quite the next best thing to do is to buy this little book of Mr. Johnson's, for therein the reader will learn how to conduct a series of interesting experiments, all of which will lead him to a more precise acquaintance with the fascinating and wonderful ways of this perfectly natural, although little understood, phenomenon.

FLIGHT

AVIATION AND COMMON SENSE.

By F. I. WILBUR.

IN the enthusiasm aroused by the recent sudden and wonderful developments in the line of aerial navigation, the aviators seem to have lost sight of certain principles of common sense, the observance of which would have protected them from many of the discomforts, dangers and tragedies of the past.

As a consequence of this oversight it has been said that many of the most famous aviators, such as the Wright Brothers, Blériot, Farman, Paulhan, Duray, Gibbs, Rougier, Sommer, &c., have been obliged to abandon the sport of flying because of accidents or because of the impairment of their health and nerves by ruined heart action, strained lungs, or attacks of vertigo and similar troubles in the air. As a result of experience it is suggested that the intense nervous strain of flying will, in a short time, so wreck the strongest nerves as to render a man unfit to go aloft under conditions requiring an absolute control of himself and instantaneous action in emergencies. In this suggestion a probable explanation of some of the apparently inexplicable accidents of aerial navigators is found.

Now, while it is known to physicians that the above physiological effects can all be produced by the lessened atmospheric pressure and a corresponding decrease of oxygen, which impairs the respiratory and circulatory processes of the body, it does not seem to have occurred to our aviators that the same effects have been observed to attack those who climb mountains, the lessened atmospheric pressure there producing the same symptoms of air sickness which are nearly constant in the order in which they manifest themselves with each increase of altitude. Each decrease of atmospheric pressure aggravates and accelerates these symptoms, which are collectively there called "mountain sickness."

It has also been found that practically the same symptoms attack anyone who is shut up in a pneumatic chamber. These and other facts clearly show that the disordered physiological conditions produced by aviation are primarily due to the progressive effects of a deficiency of oxygen supply.

In the air the amount of oxygen decreases with the elevation, so it must inevitably follow that the swift transition in an airship from the dense atmosphere of the earth at sea-level to lofty heights in the highly-rarefied air must result in a severe shock to the respiratory and circulatory processes, and that the effects, though transient at first, must, unless counteracted, tend to become chronic if the flights in the air are often repeated or are too prolonged.

At the surface of the earth at sea-level every square inch bears a weight of about 15 lbs., while at a height of a little over three miles above it the air pressure is found reduced one-half. Between these two points there is a gradual lessening of the air pressure, which has a mechanical effect on the respiratory activity of men and animals, altering it in proportion to the varied tension and density of the air.

These changes chiefly affect—(1) Respiration; (2) The action of the heart; (3) Those functions of the muscular and nervous system which are dependent on the amount of oxygen in the blood; (4) The distribution of the blood in the vascular system.

Oxygen is chemically attracted and bound by the blood cells, and the blood of an animal at rest is normally saturated with it. Moritz and Traube found that the oxidations of the body occur in the cells and not in the lungs or blood. It has been found that when the external air pressure is greatly reduced the cellular oxygen is drawn upon to supply the atmospheric deficiency, and air is given off from the blood to help the system in its struggle for existence.

The haemoglobin of the red blood corpuscles carries oxygen to the body tissues. An increase in altitude is found to increase the number of red blood corpuscles, but they are diminished in size. Lack of oxygen produces deterioration and toxic conditions in the body from the retention of waste products in the lungs and glands. Gland cells deprived of oxygen decompose to a state of liquefaction.

Pravaz and Campana have shown that the lungs are expanded only by the air pressure, and that when this is diminished the elastic resistance of the lungs is hard to overcome and the contraction of the lungs is more rapid and intense. The lungs of animals who die in rarefied air are found to have become atelactic, and sink in water.

In the case of growing children it is found that a deficiency in the oxygen supply tends to produce dwarf formation, for growth is impossible without oxygen. It does not seem advisable, therefore, for children to indulge in air-riding to any extent.

The brain is known to require a large amount of oxygen in order properly to perform its functions. Indeed, it is now held that the evolution of mental phenomena is essentially a chemico-vital process in which oxygenation of the cell plasma is the great feature. There is an exceptionally intimate relation between the oxygen-carrying arterial blood and cerebral function. Venous blood is absolutely fatal to normal intellectual activity, hence a progressive impairment of the mental faculties naturally follows every decrease in the oxygenated arterial blood supply.

The skin has been found to be an absorber of oxygen, and hence is unpleasantly affected by a decrease in the atmospheric supply of it.

As the oxidation processes in the body are usually accompanied by heat and light, it is perfectly natural that a lack of oxygen should be followed by a lowering of bodily temperature, which necessitates the use of warmer clothing in aerial navigation than would ordinarily be required.

W. and E. Weber discovered in 1835 that the air pressure helped to retain the femur in its socket, and Dr. Faraboeuf estimated that if the air pressure fell very greatly the joint would become loose. It is probable, therefore, that very lofty or long-continued flights in the air might produce lameness, weakness or trembling in the lower limbs.

A fact of significance to aviators is that the seats of growth of the bacillus of tuberculosis in the body correspond to situations where there is a low pressure of oxygen. It ceases to grow in the presence of a high oxygen percentage. The development of tuberculosis, however, seems to depend on the conditions of cellular oxygenation rather than on the oxygen furnished directly from the air, for inhalations of oxygen have been found to be of no benefit in the treatment of tuberculosis, although they are advantageous in cases of air-sickness and in athletic exercises. Visits to high altitudes are found to be especially injurious to those with heart disease or pulmonary emphysema.

The advantage of carrying bags of oxygen to inhale in the high altitudes was long ago found by balloonists, and has recently been successfully used in mountain climbing. Its usefulness having been thus tested, is here commended to aviators.

Sometimes the symptoms of deoxygenation become troublesome after even a change of 1,000 ft. or less of altitude; at greater heights they are naturally more marked. In the Peruvian highlands newcomers to the city of Cerro, which is over 14,000 feet above the sea, have the symptoms of mountain sickness in a chronic form for a long time. The symptoms of slight headache, vertigo, weakness of the limbs, a frequent and accelerated pulse without fever, nausea, faintness, coldness in the hands and feet, and a feeling of drowsiness followed by unrestful slumbers and great oppression at night, usually last only from six to twelve days, but the symptoms of lassitude and difficult respiration generally last a year before the person gets acclimatised. This is evidently because the lung is the only organ of the human body whose activity can be mechanically altered by the effect of atmospheric pressure. This must be especially considered in making flights from places like Denver, Col., having a high altitude above sea-level.

With this brief preliminary survey of the physiological conditions, let us consider somewhat in detail the specific effects which follow a decrease in atmospheric pressure.

In a most interesting and scientific article on mountain sickness, much of which we quote here, George von Liebig has given a review of the conditions and symptoms which, in various parts of the world, have been found associated with decreased atmospheric pressure. For the benefit of aviators who have not studied the subject we here give a brief summary of them.

The symptoms are—(1) Increased frequency of the pulse, especially under exertion; (2) Lessened fulness of respiration: if one walks frequent pauses are necessary in order to take deeper breath; (3) An unusual weakness in the lower limbs, necessitating frequent rests; (4) Great palpita-

tion of the heart and often painful consciousness of the acceleration of the heart beats; (5) Throbbing of the arteries; (6) Shortness of breath; (7) Flickering before the eyes, which sometimes become injected; (8) Sensation of faintness, sometimes with nausea or vertigo; (9) Eating becomes difficult, sometimes impossible, but it is better to eat if the right foods are at hand; (10) The drinking of the stronger alcoholic liquors is rejected; (11) Coldness of the hands and feet.

These are the ordinary symptoms. In mild cases only lassitude, nausea and headache are present, but in severe cases there may be irresistible drowsiness, confusion, embarrassed mental activity, despondency and indifference to everything, even danger.

As the decrease in the oxygen supply progresses there is a constant depletion of the blood in the left ventricle of the heart and the arterial system. In case of death from atmospheric deoxygenation, Hoppe discovered that these were always found empty, while the right ventricle and lungs would be found filled with blood. As the blood in the arterial system decreases there is always a corresponding swelling of the veins of the face, arms and hands, and a decrease in the activity of the mental faculties.

The face next becomes livid. Lividity of the hands and lips is considered a certain indication of a lack of oxygen in the blood. This symptom attacked Glaisher, the English balloonist, when he reached a height of a little over 18,000 ft. above sea-level. Higher up he lost the power of movement in his arms and legs, then the power of sight, then that of speech, though he could still hear the voice of his companion. He finally lost hearing and all consciousness. He did not regain the use of his senses or consciousness until the balloon had descended to a lower level. This experience is particularly interesting as showing apparently the relative susceptibility of the senses to deoxygenation. The eyes seem especially susceptible, often causing severe headache and nausea, and in the Andes they often become subject to dangerous inflammations. There also the skin often swells, becomes painful and chapped, and later on desquamates.

As all of the disagreeable symptoms are less marked if the subject assume a recumbent position, it would seem advisable for airships to be so arranged that the aviator could steer the ship while lying down. This precaution should especially be taken before very long or very lofty flights are attempted.

One great danger to lofty flights is from hæmorrhages. Henri Wynmalen, the young Dutchman who some time ago went up to a height of 9,121 ft. with his Farman aeroplane, found that beyond 8,000 feet the blood oozed from his finger nails into his fur gloves and that red pearls of blood oozed from his lips. In the Peruvian highlands the mountain sickness causes various bloody discharges, and in all mountain regions it is found that at great heights there is a tendency to exudations of blood from the engorged capillaries of the mucous membranes of the body, especially of the eyelids, nose, gums and bronchi. In high altitudes even the effort to speak loudly favours the occurrence of hæmorrhages. These are all merely symptoms of that stage of deoxygenation where the arteries are depleted and the veins and capillaries too full. Plethoric and well-nourished persons are especially liable to hæmorrhages from such causes. Fat persons are also more liable than lean ones and the lean subjects, even when anæmic, recover more rapidly from the bad effects. Old persons are also more liable to, and suffer more from mountain sickness than younger persons.

The onset of many of its symptoms is bewilderingly sudden. In 1875 the aeronauts Croze, Spinelli and Sivel succumbed to atmospheric conditions at a height of over 28,000 ft. The mouths and noses of their dead bodies were found filled with blood which had exuded from their mucous membranes. These men had been provided with bags of oxygen, but had evidently forgotten to use them or had been too dull, stupefied, or weak to do so.

Even the slightest thinking becomes a difficult or trouble-some effort in high altitudes. Saussure found at one time on the summit of a mountain that he felt pretty well except for nausea so long as he kept still and kept his mind tranquil; but as soon as he began to think even of his recent observations, disagreeable symptoms asserted themselves and he had to rest in order to breathe. Every exertion causes a more rapid passage from the arteries into the venous system and larger quantities of blood are thus brought into the right heart. The contraction of the lungs prevents this from escaping, and the blood thus accumulates in the veins, so that even when at rest the limbs receive less oxygen. Exertion thus causes an increased demand for oxygen. In experiments in a pneumatic chamber Bert found that the inhalation of an oxygen-rich air mixture relieved the vertigo, nausea, muscular tremor and embarrassed mental power caused by deoxygenation, and enabled him to stand a much greater reduction in air pressure.

Since mental activities are so dependent on arterial blood and oxygen, aviators should heed the first symptoms of weakness and take measures immediately to ward off the more serious symptoms that may speedily follow and endanger their present safety and future health. In high altitudes it is often noted that the will is apt to become paralysed, the mind dull and dejected, and that even reading becomes impossible because of the sensitiveness of the eyes. It would be well, therefore, for aviators to carry the different kinds of food and remedies in bottles or receptacles of different shapes, so that in case of impaired vision the fingers could distinguish them without the aid of the eyes.

Aviators should also be careful to dress in a way to conserve the bodily heat and to avoid attempting flights when their nerve force is weakened by fatigue, hunger, discouragement, or a cold or sultry atmosphere, for these weaken one's nerve force and thus aggravate the conditions of laboured respiration produced by the lessening of atmospheric pressure. Any influences which in the first place suppress evaporation from the body when freely perspiring also weaken the nerve force.

Explorers of high mountain regions in various parts of the world have found that there are certain remedies which cure or modify the distressing symptoms of mountain sickness. Some of these, which have been tested by centuries of experience, are here recommended to aviators.

(1) Inhalation from bags of oxygen.

(2) Little nourishment frequently taken, even where an aversion to food exists. In the Himalayas they take onions and acidulous fruits, dried apricots and prunes. In the Andes they drink an infusion of cocoa leaves frequently. Cocoa, unlike tea or coffee, has nutritive rather than stimulating qualities, besides which it is in the Andes considered to be a nervine and is used as such. Mountain climbers drink much of it.

(3) Gentle laxatives to excite the circulatory organs. In the Andes they use such things as lemonade, cream of tartar or tamarind pulp. They also sometimes use ice.

(4) Garlic or fruit of capsicum. In some cases the mere smell of garlic is found to be a sufficient restorative. Horses, mules, oxen, camels and even dogs and cats are all subject to mountain sickness. In the Andes, when any animal becomes affected by it, the natives rub garlic or pounded fruit of capsicum on their noses to give them relief.

(5) Bleeding. In the Andes they sometimes resort to bleeding to relieve the animals suffering from a congestion of blood in the capillaries. This is generally done by cutting a piece from the ears or making a cut in the palate or a slit in the nostrils.

While our æsthetic notions of the ethereal pleasure of aviation may suffer a shock at the thought of loading an airship with onions, garlic, &c., yet as a matter of common sense it would seem advisable for an aviator before either attempting or renouncing the fascinating pastime to adopt the above or some of the other commonplace remedies or customs whose usefulness has been already demonstrated in mountain and balloon ascents.

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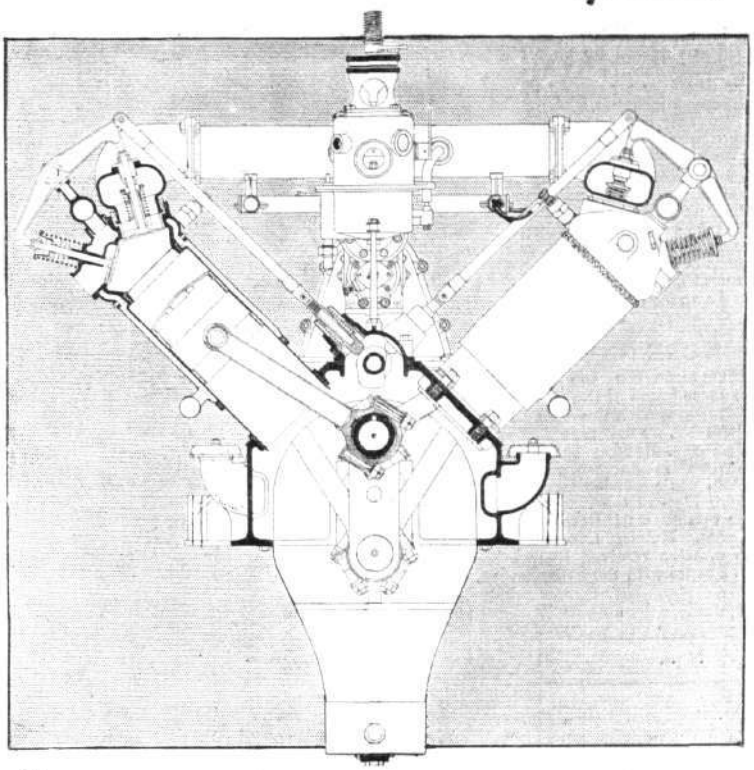
The "Deutschland" in Commission Again.

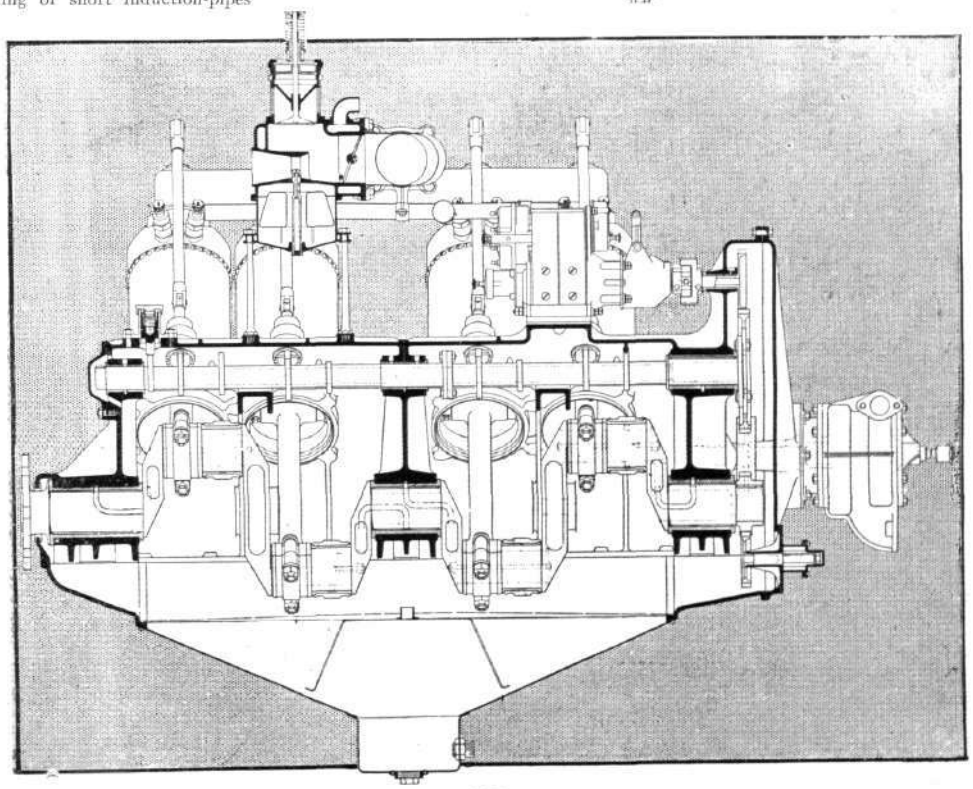
HAVING been completely repaired, the Zeppelin aerial liner "Deutschland," after making a preliminary trial above Dusseldorf on the 25th ult., started off on a long excursion, and passing over Neuss, Rheydt and Fulich, arrived at Aix-la-Chapelle 2 hrs. 20 mins. after starting. Half-an-hour was spent in cruising over the city, and then the return journey was commenced, the airship eventually arriving safely back at the hangar, in about half the time occupied on the outward trip.

THE 120-H.P. "VEE" TYPE WOLSELEY AERO ENGINE.



This engine is designed to suit either aeroplane or dirigible requirements, and is of the "Vee" type, having eight cylinders, each 5 in. bore by 7 in. stroke. These are separate and are mounted in two rows on an aluminium crank-case at an angle of 90°. The cylinder walls are of high carbon steel, machined and ground to gauge, while the combustion chambers are of close-grained cast iron, and are screwed into the tops of the cylinders. Spun aluminium is used in the construction of the water-jackets, which are securely screwed and jointed to the combustion heads, the bottom joint being made by means of a dermatine ring. The cooling water is circulated by a positive gear pump. Both induction and exhaust valves are mechanically operated by means of a single cam and rocking lever. This rocking lever is operated from the cam-shaft by means of a plunger and tappet rod.

A carburettor specially suitable for aeroplane requirements is fitted, and is of the float feed spray type with an annular float. It is mounted in the centre of the engine, between the cylinders, this arrangement allowing of short induction-pipes



and an even distribution of gas. Pressure for the petrol feed is supplied by an air pump embodied in the engine. The main throttle is compensated and hand controlled, and the auxiliary air supply to the carburettor is obtained from the crank-chamber.

Ignition is on the Bosch dual system, comprising high-tension magneto, with coil and accumulator for starting.

Lubrication is on the forced system, by means of rotary pumps which continually circulate the oil. These pumps are of the tandem pattern, that is to say, while one pump draws oil from a separate tank and forces it to all the important bearings, the other draws oil from the crank-chamber and returns it to the tank. The gudgeon-pins and cylinder walls are lubricated by splash. Vickers nickel chrome steel is used for the crank-shaft, which is carried in three bearings, and also for the connecting rods, the latter being oil hardened. The big-ends are bushed with white metal. A totally enclosed gearing drives the hardened steel cam-shaft, which has its cams cut from the solid.

Three piston-rings are fitted to the pistons, which are of drawn steel. The top ring is of cast iron, and the other two, one at the top, just beneath the iron ring, and the other at the bottom, below the gudgeon pin, are of phosphor bronze.

The total weight of the engine as above detailed, complete with magneto, wiring, all water pipes on engine, water pump, oil pumps and connections, but exclusive of fly-wheel and exhaust pipes, is under 580 lbs. Before leaving the works the engine is tested on the bench for four hours, and is guaranteed to develop continuously not less than 120-b.h.p. when running at 1,150 r.p.m., with a maximum of 140-b.h.p. for a short period at a higher rate of speed.

MORE CONTINENTAL AVIATORS.

SUPPLEMENTING the lists which have already appeared in these pages of the pilot aviators who have obtained their certificates from the Aero Clubs of Great Britain, France and Germany, we now give similar particulars relating to Austria, Denmark, Sweden and Switzerland. It will be seen that Austria has nineteen pilots, Denmark and Switzerland three each, while Sweden has only one. We are informed by the Aero Club of the Netherlands that so far they have issued no certificates themselves, but six of their members, Koolhoven, Kuller, Labouchere, Lutge, Van Riemsdyk and Wynmalen received their certificates from the Aero Club of France with the authorisation of the Dutch A.C.

AUSTRIA.

Name.	Country.	Date of Birth.	Where Born.	Machine	Qualified.	No.
Auer, Josef	Aus.	— 85	Amstettin	Bl.	22 Ja., 10	6
Bier, Heinrich	,,	1 No., 82	Prague	Bl.	20 Oc., 10	18
Booms, Wilhelm	,,	21 Jy., 74	Maner, Vienna	Far.	29 Jy., 10	9
Economo, Baron Constantin	,,	21 Au., 76	Trieste	Vois.	13 Jy., 10	7
Fiedler, Paul	,,	18 Fe., 84	Sternberg	Fie.	22 De., 10	19
Flesch, Josef	,,	2 Ma., 71	Vienna	Vois.	17 Au. 10	11
Hieronimus, Otto	,,	26 Jy., 79	Cologne	Hier.	9 Se., 10	17
Kolowrat, Count Alex	,,	—	Glendrige, U.S.A.	Vois.	14 Se., 10	15
Illner, Karl	,,	—	Schatzlar	Et.	25 Ap., 10	3
Miller, Miexislaus	,,	3 Fe., 77	Cracow	Bl.	22 Ju., 10	5
Petroczy von Petrocz, Stephen	Hun.	—	Gut Petrocz	Wgt.	28 Jy., 10	13
Pischoff, Ritter von A.	Aus.	—	Vienna	Pis.	24 Ap., 10	2
Sablating, Josef	,,	9 Se., 86	Klagenfurt	Wgt.	24 Au., 10	12
Simon, Rudolf	,,	16 Ju., 76	Brüx	Loh.	13 Ju., 10	4
Stoharzl, Karl	,,	— 79	Iglau	Vois.	30 Au., 10	14
Umlauf, Ritter von Frankwell Hans	,,	—	Brunswick	Vois.	15 Au., 10	10
Warchalowski, Adolf	,,	—	Vienna	Far.	22 Ap., 10	1
Warchalowski, Karl	,,	27 Jy., 79	Vienna	Far.	27 Jy., 10	8
Wiesenbach, V.	Lux.	—	Luxemburg	Wgt.	10 Oc., 10	16

DENMARK.

Nervö, Alfred C.	Dan.	10 Se., 79	—	—	30 Ju., 10	3
Svendsen, Robert	,,	10 De., 84	—	—	15 Ja., 10	1
Thorup, Knud	,,	16 Ja., 86	—	—	15 Ja., 10	2

SWEDEN.

Cederström, C.	Sd.	5 Ma., 67	Sweden	Bl.	27 Ju., 10	1

SWITZERLAND.

Durafour, Francois	Sw.	—	Geneva	Du.	—	—
Faillonbaz, Ernest	,,	21 Jy., 72	Avenches	Bl.	—	—
Taddeoli, Emile	,,	8 Ma., 79	Geneva	Du.	—	—

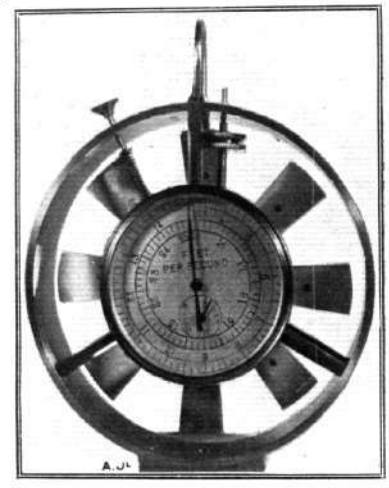
Country—Aus. = Austria; Dan. = Denmark; Hun. = Hungary; Lux = Luxemburg; Sd. = Sweden; Sw. = Switzerland.
Machine.—Bl. = Blériot; Du. = Dufaux; Et. = Etrich; Far. = Farman; Fie. = Fiedler; Hier. = Hieronimus; Loh. = Lohner; Pis. = Pischoff; Vois. = Voisin; Wgt. = Wright.

The Wright Patents in France.

A DEFINITE step forward has now been taken by the French Courts in the litigation over the French Wright patents. It will be remembered that some time ago several French constructors were proceeded against for infringement of the Wright patents, and although it has been practically decided by the Court that the plaintiffs have great justification for their claim, the ultimate judgment depends largely on whether the plaintiffs' invention has or has not been anticipated, and whether the defendants have or have not, on the top of the claimed invention, developed an absolutely new invention. Under the circumstances, therefore, the Court has referred the matter for report to three experts, consisting of MM. Marcel Desprez and Leaute, of the French Institute, and Commandant Renard. With regard to M. Santos Dumont, as one of the defendants, the Court has decided in his favour, on the ground that his work was wholly scientific, and his infringement, if any, had no commercial purpose in view.

A SELF-TIMING ANEMOMETER.

ORDINARY anemometers of the fan type for measuring the speed of the wind only really make a direct measurement of the quantity of wind passing through the instrument, and the simultaneous use of a watch is necessary in order to obtain the time whereby the reading of the anemometer may be converted into velocity. While this is not perhaps such a great inconvenience in the case of observations that are made on terra firma, it really places such devices out of the question for the use of machines in flight, and in any case the instrument now introduced by John Davis and Sons of Derby, which records velocity direct, marks an important advance on the older method.



The Davis self-timing anemometer has the orthodox external appearance, and consists of the usual windmill enclosed in a brass ring and fitted with a recording dial in the centre. The operation of this instrument is as follows: the casing is held back to wind so that the dial faces the observer, and the vanes are allowed to rotate for a second or two in order to get well under way. The plunger on the left of the outer ring is then depressed, and the pointer on the dial is thereby caused to indicate the speed of the wind. To reset the hand to zero a small milled head screw between the dial and the outer ring is turned down until the plunger is released, and finally unscrewed as far as it will go. It is obvious that the simplification of this latter process in connection with the resetting of the pointer would be very desirable, but detail improvements of this sort are bound to follow once the general principle of the instrument is proved to be practicable.

FLIGHT

ATMOSPHERIC FRICTION.*

By A. F. ZAHM.

THE following article contains the most reliable data that have yet been collected on the subject of atmospheric friction, and establishes the law governing this resistance. Atmospheric friction, or skin friction, as it is generally called, has been considered by some writers to be negligible: Zahm's experiments conclusively prove that it is not negligible, but that it must constitute approximately one-half of the total resistance to flight when the conditions are those of minimum resistance.

Zahm's law and coefficient of skin friction, as established by the experiments described below, is as follows: $R = \cdot 0000316\, l'^{\cdot 93} V^{1\cdot 85}$, where R = resistance, in lbs. per ft. of span, l = chord length of surface, and V = flight speed in m.p.h.

Converting the index of l to unity, the nearest approximation to Zahm's law in the form of a V^2 expression is obtained by the formula R (lbs. per sq. ft. of double surface) = $\cdot 000018\, V^2$, which gives the same result for a flight speed of 40 miles an hour, and affords a rough approximation from zero to 90 miles an hour.

The above approximation is only justifiable when the aspect-ratio is high, for if the chord is greater than the span its fractional index cannot be neglected without serious error. For example, consider an area of 300 sq ft. represented by a span of 50 ft. and a chord of 6 ft. Allowing for the index of l, the effective chord becomes $6^{1\cdot 85} = 5\cdot 4$, and the effective area 270 sq. ft., which is 10 per cent. smaller than the full measurement. If, on the other hand, the chord is 50 ft. and the span only 6 ft., the effective chord value will be $50^{1\cdot 85} = 38$ ft., and the effective area only 228 sq. ft., which is 24 per cent. less than the full amount.

At higher speeds than 90 m.p.h. the discrepancy between $V^{1\cdot 85}$ and V^2 is very important, and must be considered in estimating the friction of propeller-blades, which travel through the air at very high speeds.

Measurements.

THE experiments here described were made to determine the magnitude of the friction of air flowing over even surfaces, both smooth and rough ones, and the law of its variation with the speed of flow, the length, and quality of surface. The primary purpose of the investigation was to establish a basis for calculations in engineering, and particularly in aerial navigation; but it is hoped that the measurements are sufficiently accurate to be of value also to the general dynamics of fluid motion.

It has long been known to marine science that in a well-formed vessel one of the chief elements of resistance is the skin-friction of the water on its sides; and, by analogy, it was surmised that a fair-shaped body in the air might be retarded in a similar way by the tangential drag of that fluid. But the measurements of several prominent experimenters led them to affirm that the skin-friction of the air is negligible, even for bodies of fair outline. The present research, however, seems to prove that the frictional resistance is at least as great for air as water, in proportion to their densities. In other words, it amounts to a decided obstacle in high-speed transportation. In aeronautics it is one of the chief elements of resistance, both to hull-shaped bodies and to aero-surfaces gliding at efficient angles of flight. It seems important, therefore, that the main laws of this resistance should be carefully determined.

To measure the tangential force of the air on even surfaces, various skin-friction planes were suspended inside a wind-tunnel by means of two fine steel wires attached to the top of the laboratory, as shown

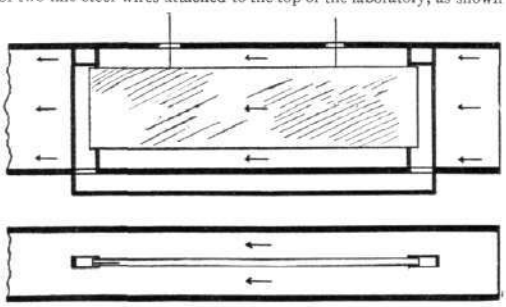


Fig. 1.—Section of wind-tunnel with suspended skin-friction plane.

in Fig. 1. The tunnel itself, standing on the floor of the laboratory, measuring 40 ft. long by 6 ft. square, has a 5-ft. electric suction-fan at one end, and a cheese-cloth screen, or two, at the other, to straighten the current of inflowing air. A boy with a rheostat and tachometer holds the fan at any desired speed, accurately to a fraction of 1 per cent., thus giving an even flow of air of like constancy. As the wind-friction moves the plane endwise the displacement is determined by the motion of a sharp pointer attached to one suspension wire and travelling over a fine scale lying on top of the tunnel. The swing of the plane can be measured accurately to $\frac{5}{1000}$ths of an inch, and the force on the plane is exactly proportional to the scale readings. The wind-speed is usually measured by a pressure-tube anemometer, though other kinds have been employed for comparison.

In the first attempt to determine the coefficient of skin-friction a thick plane was used, having wind-shields fore and aft, as shown in Fig. 1, to protect it from end-thrust. The plane is 16 ft. long, 4 ft. wide, and 4 ins. thick. The shields are made of sheet zinc, their cross-section measuring $4\frac{1}{2}$ by 12 ins. inside, and each shield closely envelops one end of the plane, yet has ample space farther within to allow the air to flow very freely from one shield to the other, through a large connecting pipe underneath the floor of the tunnel, thus equalising the pressure. This pipe, or flue, measures 1 sq. ft. in cross-section.

The static pressures in the two wind-shields deserve careful attention. If they are equal, the resultant end-thrust is nothing, and the only deflecting force on the plane is the friction of the air along its sides. But in practice there is a difference of static pressure, which is measured by connecting the shields, by means of rubber hose, to a differential pressure-gauge graduated to millionths of an atmosphere, and usually read to one-ten-millionth.† Computing the end-thrust from the differential pressure, and adding or subtracting the result, gives the total skin-friction on the plane. The correction thus introduced is about 5 per cent. of the whole deflecting force.

Considerable care was taken in the design of the plane to make it light and keep it perfectly straight. A frame was made of organ tubes and covered with paper in such a way as to be adjustable for warpage. As shown in Fig. 2, the paper is glued, not directly to the organ-tube frame, but to $\frac{1}{2}$-in. boards which slide over the four outer faces of the frame. As the paper was fastened on wet, it now remains very taut on all but the dampest days, and of course holds the sliding pieces firmly to the frame. The process of adjustment is as follows: The two end sliding pieces are set vertically by means of plumb-lines, thus bringing the four corners accurately into a mathematical plane. The four corners are then drawn by tight

Fig 2.—Cross-section of 16-ft. plane, showing paper glued to sliding pieces.

threads and the other sliding pieces tapped into line with a mallet. The operation requires less than half an hour, and the plane can easily be made true to less than $\frac{1}{32}$ of an inch. The warpage of the 16-ft. plane sometimes amounts to $\frac{1}{4}$th of an inch in twenty-four hours, and may be more than a $\frac{1}{4}$ of an inch in several days; but in practice the plane is kept straight by timely adjustment.

During each experiment one assistant controlled the fan speed by means of a rheostat, and noted the revolutions per minute with a

* Paper read before the Philosophical Society at Washington, February 27th, 1904.

† See "Measurement of Air Velocity and Pressure," *Physical Review*, December, 1903.

Schaeffer and Budenberg tachometer; another assistant read the deflection of the plane, while a third observed the differential pressure in the wind-shields by means of a manometer, and the wind velocity as given by a pressure-tube anemometer or a Robinson cup anemometer. The duration of an experiment was usually about an hour and comprised ten different wind velocities.

The following page from the laboratory note-book for January 30th, 1903, gives the results obtained after some skill had been acquired in using the various instruments. Similar observations had been taken in July, 1902, and this much of the present paper was communicated to the American Association for the Advancement of Science in December, 1902.

A few essential data may be prefaced: surface of plane between wind shields, 138·08 sq. ft.; cross-section of plane, 202·1 sq. ins.; weight, 58 lbs.; 1-in. swing of plane = 0·296 lb. deflecting force; 1 milligrame per square centimetre differential pressure in the wind shields equals 0·00287 lb. end-thrust on the plane; mean temperature of experiment, 4·5° C.; barometric pressure, 29·74 ins.; time, 3.30 to 4.30; weather, dry; mouth of tunnel not screened.

TABLE I.—*Skin-friction on Plane Measuring 16 ft. × 4 ft. × 4 ins.*

Speed of Fan.	Swing of Plane.	Force Causing Swing.	Differential Pressure in Shields.	End-thrust on Plane.	Pressure-tube Anemometer.	Wind Speed.	Friction per Square Foot.
r.p.m.	in.	lbs.	mg. sq. cm.	lbs.	mg. sq. cm.	ft. sec.	lbs.
150	0·27	0·080	0·0	0·0	70	11·11	·000579
200	0·41	0·121	0·0	0·0	105	13·63	·000875
250	0·54	0·160	0·0	0·0	155	16·16	·001156
300	0·76	0·225	1·0	0·003	225	19·46	·00165
350	0·95	0·277	1·7	0·005	295	22·30	·00203
400	1·19	0·352	3·9	0·011	375	25·14	·00262
450	1·45	0·428	7·1	0·019	465	28·0	·00324
500	1·74	0·515	9·5	0·026	570	31·0	·00392
550	2·04	0·603	13·7	0·037	670	33·6	·00463
600	2·39	0·701	16·5	0·045	815	37·0	·00539

The force in the third column is computed from the observed swing of the plane. Adding the end-thrust, since the differential pressure opposed the deflection of the plane, there results the actual skin-friction on the exposed surface. Dividing by the area of the surface gives the values recorded in the last column. The wind speed is computed from the pressure-tube readings by a theoretical formula, which has been carefully verified by a special series of experiments which were published in the *Physical Review*, December, 1903.

The values of the wind velocity and skin-friction have been plotted on logarithmic cross-section paper, as shown in Fig. 3.

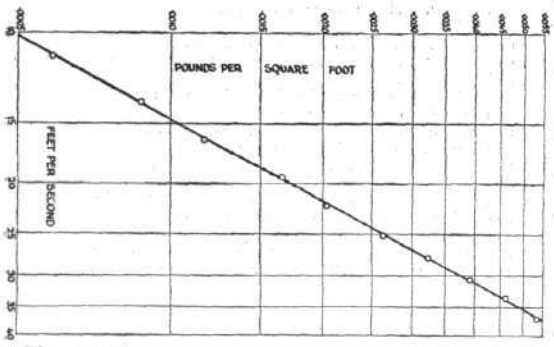


Fig. 3.—Relation between velocity and unit friction for 16-ft. plane.

Their relation in this, as in subsequent experiments, is invariably expressed by a straight line—that is, by the relation, $F = av^n$ . . (*a*) in which F is the total friction, v the wind speed, a, n, numerical constants. The concrete relation obtained from the numerical values of table I is, for a plane 16 ft. long,

$$f = 0{\cdot}00000671\, v^{1{\cdot}86} \quad . \quad . \quad . \quad . \quad (v = \text{ft. sec.}),$$
$$f = 0{\cdot}00001363\, v^{1{\cdot}86} \quad . \quad . \quad . \quad . \quad (v = \text{mi. hr.}),$$

in which f is the average friction in pounds per square foot of surface, and v is the wind velocity in the units indicated within the parentheses. This relation was corroborated by later experiments in which no wind-shields were used.

Having fairly established the law of variation of the skin-friction with the air velocity, an effort was made to discover its variation with the length of surface. A simpler method was then adopted which had been considered, but was discarded in the beginning as appearing hardly delicate enough to measure such extremely small forces as the friction was at first conceived to be.

Planes were now constructed similar to those commonly used to determine the skin-friction of water. The first was a pine board 4 ft. long, 25·5 ins. wide, and 1 in. thick, carefully trued and varnished, and suspended in the wind-tunnel, as usual, by steel wires 0·025 of an inch in diameter. It was provided with a 7-in. pine prow and stern, both of ogival form. These were held on by dowel-pins, as shown in Fig. 4, and each terminated in a sharp edge, from the centre of which a steel pin protruded along stream

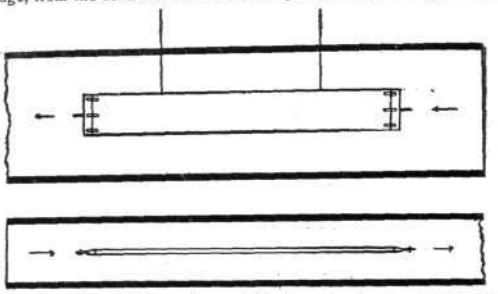


Fig. 4.—Skin-friction plane with sharp ends, suspended in wind-tunnel.

between guides to steady the plane against wobbling. As the dowelling was carefully executed, straight planes of any length could be made by adding extra boards, the lengths most employed being 2, 4, 8, 12 and 16 ft.

The method of using the planes to determine the surface-friction was as follows:—The total force was measured, at various velocities, using the prow and stern first on the 16-ft. board, then successively on the 12, 8, 4 and 2-ft. boards, and finally with nothing between them. Subtracting this last force from each of the others gave the friction on those five lengths. It may not be absolutely true that the end resistance was the same for each of those lengths, but the error of this assumption is regarded as very slight for several reasons: (1) The end resistance is but a small part of the total; (2) the stream lines are so slightly disturbed that the flow about the ends must be practically the same in all cases; (3) the results harmonise very well with those obtained by other methods.

Table II, taken from the laboratory note-book, exhibits the observed and computed values for the 2-ft. friction-board. The mouth of the tunnel was screened with cheese-cloth to steady the flow of the air, in order to obviate wobbling in so small a board. The velocity was thus reduced, it is true, but sufficient values are given to make a reliable diagram.

The following data may be prefaced: Surface of the 2-ft. plane without prow and stern, 8·83 sq. ft.; weight of plane with end pieces, 17 lbs.; 1-in. swing of plane = 0·0862 lb. wind force; barometric pressure, 29·80 ins.; mean temperature of experiment, 24·2° C.

TABLE II.—*Surface Friction by 24 ins. × 25·5 ins. Pine Board with Prow and Stern.*

Speed of Fan.	Swing of Plane.	Force Causing Swing.	Force on Prows.	Net Friction.	Pressure-tube Anemometer.	Wind Speed.	Friction per Square Foot.
r.p.m.	in.	lbs.	lbs.	lbs.	mg. sq. cm.	ft. sec.	lbs.
200	0·050	0·00431	0·00233	0·00198	22·8	6·38	0·000224
250	0·080	0·00690	0·00365	0·00325	37·0	8·12	0·000368
300	0·120	0·01034	0·00553	0·00481	58·0	10·18	0·000545
350	0·158	0·01362	0·00734	0·00628	78·5	11·80	0·000710
400	0·205	0·01767	0·00949	0·00818	103·5	13·52	0·000925
450	0·260	0·02240	0·01188	0·01052	132·0	15·34	0·001188
500	0·310	0·02586	0·01379	0·01207	155·0	16·61	0·001366

The third column gives the whole force on the friction-board with its prow, stern, and suspension wires. The fourth column gives the force on the latter alone, which, deducted from the whole force, gives the friction on the sides of the 2 ft. length. Dividing this net friction by 8·83, the area of the true friction surface, gives the values in the last column.

Similar tables were obtained for the other friction-boards, of lengths 4, 8, 12, and 16 ft. respectively. When the values from the five tables are plotted on logarithmic cross-section paper they give five separate straight lines, all having the same inclination as the one shown in Fig. 3, in which the slope tangent is 1·85. This means that, for all the velocities and lengths of surface employed in this research, the skin-friction is expressed by an equation of the form $F = av^{1\cdot85}$ . . . . (β), a being a numerical constant, and v the wind speed. Hence if the net friction on each board is known for any velocity, it can readily be computed for any other velocity.

In practice the computations illustrated in Tables I and II were obviated, for all the tables, by a simple expedient. The observed anemometer readings and swing of the plane were plotted while the measurements were in progress, giving five straight lines, all of the same slope. Then a point was selected on each line representing a wind speed of 10 ft. per sec., and the corresponding friction per square foot of surface noted. From these values the numerical equations between F and v can at once be written. The observed values are given in the subjoined table :—

TABLE III.—*Skin-friction at 10 ft. per sec. for Various Lengths of Surface.*

Length of friction board	2	4	8	12	16
Average friction, lbs. per sq. ft.	0·000524	0·000500	0·000475	0·000467	0·000457

Knowing, then, the friction at the same speed on five different boards, there remained to determine the law of its variation with length of surface. To that end, the values in Table III were plotted on logarithmic cross-section paper, as shown in Fig. 5. The result is a straight line whose equation is of the form,

$$f = al^{-0\cdot07}$$

whence $$F = fl = al^{0\cdot93} \quad . \quad . \quad . \quad (\gamma),$$

in which f is the average friction in pounds per square foot, and l is the length of surface in feet. At 1 ft. per sec. the coefficient is 0·00000778; hence at any speed, v feet a second, the average friction per square foot is

$$f = 0\cdot00000778\, l^{-0\cdot07} v^{1\cdot85} \quad . \quad . \quad (v = \text{ft. sec.}),$$
$$f = 0\cdot0000158\, l^{-0\cdot07} v^{1\cdot85} \quad . \quad . \quad (v = \text{mi. hr.})$$

Assuming the two laws thus far derived to be true for the planes and wind speeds employed, we may readily express the total friction on a plane of any length from 2 ft. to 16 ft., moving at any speed from 5ft. to 40 ft. a second. Thus, by the last equation, the total friction, F, on a surface 1 ft. wide and 1 ft. long is

$$F = fl\, 0\cdot00000778\, l^{0\cdot93} v^{1\cdot85} \quad . \quad . \quad (v = \text{ft. sec.}).$$
$$F = 0\cdot0000158\, l^{0\cdot93} v^{1\cdot85} \quad . \quad . \quad (v = \text{mi. hr.})$$

Of course this value of F must be doubled for a material plane of length, l, and width 1 ft., since a material plane has two sides.

In order to facilitate the computation of skin-friction in practice, the following table has been derived from the equation

$$f = 0\cdot0000158\, l^{-0\cdot07} v^{1\cdot85}.$$

The friction for any intermediate velocity, or length of surface, may be found by interpolation. If the surface is of variable length, it may be divided into longitudinal strips, the force on each strip being the product of the area of the strip multiplied by the average friction for its particular length. Only the values in heavy type lie within the range of the experiments above described.

TABLE IV.—*Friction per sq. ft. for Various Speeds and Lengths of Surface.*

Wind Speed. mi. hr.	Average Friction in lbs. per sq. ft. 1 ft. Plane.	2 ft. Plane.	4 ft. Plane.	8 ft. Plane.	16 ft. Plane.	32 ft. Plane.
5	0·000303	**0·000289**	**0·000275**	**0·000262**	**0·000250**	0·000238
10	0·00112	**0·00105**	**0·00101**	**0·000967**	**0·000922**	0·000878
15	0·00237	**0·00226**	**0·00215**	**0·00205**	**0·00195**	0·00186
20	0·00402	**0·00384**	**0·00365**	**0·00349**	**0·00332**	0·00317
25	0·00606	**0·00579**	**0·00551**	**0·00527**	**0·00501**	0·00478
30	0·00850	0·00810	0·00772	0·00736	0·00701	0·00668
35	0·01130	0·0108	0·0103	0·0098	0·00932	0·00888
40	0·0145	0·0138	0·0132	0·0125	0·0125	0·0114
50	0·0219	0·0209	0·0199	0·0190	0·0181	0·0172
60	0·0307	0·0293	0·0279	0·0265	0·0253	0·0242
70	0·0407	0·0390	0·0370	0·0353	0·0337	0·0321
80	0·0522	0·0500	0·0474	0·0452	0·0431	0·0411
90	0·0650	0·0621	0·0590	0·0563	0·0536	0·0511
100	0·0792	0·0755	0·0719	0·0685	0·0652	0·0622

It may now be inquired what other circumstances alter the surface friction. Perhaps the chief of these are the atmospheric changes of density and the unevenness of surface.

No effort was made to determine the relation between the density and skin-friction of the air, partly for want of time, partly because, with the apparatus in hand, too great changes of density would be needed to reveal such relation accurately. Doubtless the friction increases with the density, since it is due to the inertia of the fluid near the friction surface. Of course, in steady motion at low velocity, such as studied by Maxwell, the conditions are different. He found that when one plane moved edgewise near and parallel to another plane, at a constant speed below $\frac{1}{10}$th of an inch per

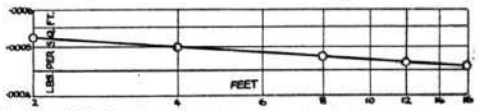


Fig. 5.—Relation between length and unit-friction at 10 ft. per sec.

second, the friction is independent of the pressure and proportional to the absolute temperature for such atmospheric conditions as prevail near the earth's surface.

Some measurements were made with the 4 ft. friction-board covered with various materials to observe the effect of quality of surface upon the tangential resistance. Practically the same friction was observed, whether the board was covered with dry varnish, or wet, sticky varnish, or sprinkled with water, or covered with calendered or uncalendered paper, or glazed cambric, or sheet zinc, or old English drafting paper, which feels rough to the touch. But when the plane was covered with coarse buckram, having 16 meshes to the inch, the friction at 10 ft. a second was 10 to 15 per cent. greater than for the uncovered surface, and the friction increased as the velocity raised to the power 2·05, or approximately as the square of the speed.

The fact that such a variety of materials exhibit practically the same friction seems to indicate that this is a shearing force between the swiftly gliding air and the comparatively stationary film adhering to the surface, or embedded in its pores. If, as seems to be true, there is much slipping, this means that the internal resistance of the air is less at the surface than at a sensible distance away. As the shearing strength of a gas is due to the interlacing of its molecules, owing to their rapid motion normal to the shearing-plane, it may be that the diminution of shear near a boundary surface is due to the dampening, within the film, of the component of molecule translation normal to the surface.

To summarise the results attained thus far, it may be said that, within the ascribed limits of size and wind speed—

1. The total resistance of all bodies of fixed size, shape and aspect is expressed by an equation of the form $R = av^n$ . . . . (α), R being the resistance, v the wind speed, a, n, numerical constants.

2. For smooth planes of constant length and variable speed the tangential resistance may be written $R = av^{1\cdot85}$ . . . . (β).

3. For smooth planes of variable length, l, and constant width and speed the friction is $R = al^{0\cdot93}$ . . . . (γ).

4. All even surfaces have approximately the same coefficient of skin-friction.

5. Uneven surfaces have a greater coefficient of skin-friction, and the resistance increases approximately as the square of the velocity.

The equation $R = av^n$ was found to express very accurately the resistance of all the shapes tested at speeds from 5 ft. to 40 ft. a second. For normal planes, spheres, cylinders, and blunt bodies generally, except very small ones, n equals 2, very approximately; for thin, tapering bodies n may have any value from 2 to 1·85; but in every case, if the form and aspect of the model remained fixed, a and n are found to remain practically invariable for all the speeds employed. This was manifested by plotting the speed and resistance on logarithmic cross-section paper and observing that the diagram was invariably a straight line for all the models tested. The statement cannot be true for a great range of speeds.

(*To be concluded.*)

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Flights as "Campaigns."

IN spite of the special allowances granted to airmen, the French Minister of War appears to hold the opinion that their pay is still not sufficient, and so M. Berteaux intends to introduce shortly into the French Parliament a Bill providing for special payments to certificated officers for cross-country flights, while the services of the aviators will count as "services in the field." On gaining his military certificate, each aviator will be credited with one "campaign," while when he has flown a certain distance that will count as another "campaign," and so on. A certain number of "campaigns" render French officers eligible for the Legion of Honour, and thus these new rules would open the way for the airmen to obtain this distinction.

FOREIGN AVIATION NEWS.

The French Military Pilots' Certificates.

ALTHOUGH the conditions are very severe a large number of French officers are finding little difficulty in qualifying for the special military pilots' certificates. One of the latest to so qualify is Lieut. Clavenad, who, on the 25th ult., flew from Vincennes to Ferte-sous-Jouarre and back on his Blériot monoplane. He covered the distance of 110 kiloms. in 1 hr. 10 mins., and during the trip maintained an average altitude of 500 metres.

On the 1st Capt. Casse, on a Henry Farman machine, accompanied by a sapper, flew from Mourmelon to Amifontaine and back, 104 kiloms., in 1 hr. 40 mins. in his second trial for the military brevet.

A Long Reconnaissance on a Sommer.

ACCOMPANIED by a passenger, Lieut. Girard on a Sommer biplane on the 27th ult. rose from Mourmelon and made a long reconnoitring trip over the surrounding country as far as Rheims. Altogether he was in the air for 1 hr. 20 mins., flying mostly at a height of about 400 metres.

A New Machine at Douai.

USING a new aeroplane, known as the "Vautour," built by MM. Allard and Carbonnier, and fitted with an "Aviatik" motor, M. Armand carried out a series of very successful trials at Douai on the 25th ult. A passenger was also carried for a short trip over the country surrounding the Brayelle Aerodrome, at a height of 100 metres.

A Fine Flight on a Nieuport.

CHEVALIER, the chief pilot of the Nieuport School at Mourmelon, made a splendid flight on the 25th ult., when, leaving the Mourmelon ground, he flew over to Rheims, then over Chalons, eventually landing before his hangar at Mourmelon after being in he air for 42 mins. 52 secs. and covering 82 kiloms. The speed of the Gnome-engined Nieuport monoplane averaged 114·5 k.p.h., while the average height was 500 metres. In the afternoon Lieut. Fequant, on a similar monoplane, but fitted with a 40-h.p. Nieuport engine, flew from Mourmelon to Rheims, carrying Lieut. de Briey as passenger.

A Maurice Farman 'Bus.

MR. MAURICE FARMAN is turning his attention to the question of passenger-carrying, and on the 25th ult., in the course of some trials, carried three passengers besides himself on his machine for a cross-country trip.

Sommer Monoplanes for the French Army.

ON Sunday, at Douzy, Bathiat, after making an hour's flight on his 70-h.p. monoplane, tested two 50-h.p. monoplanes intended for the French Army. Molla was also practising on a Sommer monoplane and was up for an hour.

One of the monoplanes built by M. Sommer for the European Circuit was tried on Monday by Bathiat, and was timed to cover 3 kiloms. in 96 secs., the speed working out to 113 k.p.h. The machine is being taken to Mourmelon by Lindpaintner with a view to capturing speed records. On the 26th ult. Lindpaintner flew from Douzy to Sedan and back, rising at one time to a height of 1,200 metres.

A New Racing Farman.

ON Monday Mr. Henry Farman was at Mourmelon making some tests with a biplane, which, among other modifications, is much smaller than the standard type. Although no actual figures have been published as to the speed obtained, it was noticeable that the new machine was very fast.

French M.P.'s at Pau.

ON the 25th ult. a large number of Members of the French Parliament and officers of the French Army and Navy paid a visit to the aerodromes at Pau. There was also a crowd of between 1,500 and 2,000 people present to witness some very fine flying by Lieuts. Princeteau, de Rose, and Malherbe on their Blériot monoplanes, while Leblanc on a two-seated Blériot machine carried MM. Louis Barthou and Millevoye for a short trip.

English Visitors at Douai.

ON Sunday last Capt. Wood and Mr. Low, who are in France n connection with the R.E.P. business on behalf of Messrs. Vickers, Ltd., paid a visit to the works of M. Louis Breguet at La Brayelle, near Douai. Although a fairly stiff breeze was blowing, the visitors were taken for a trip over Douai by Lieut. Tretarre. The "air-worthy" qualities of the Breguet machine were put to a severe and satisfactory test.

For the Coupe Pommery.

SUNDAY was the last day for the first stage of the Pommery competition, and although the weather was none too favourable four aviators tried to better the performance of Vedrines, who stood first. Pierre Marie set out on a Deperdussin monoplane for Rheims, but only got as far as Hirson. Bobba, on a Goupy, started from Juvisy and reached Etampes; Delaet, on a Caudron, flew from Crotoy to Dranmouth, on the Belgian frontier; and Lieut. Conneau, after flying from Issy to Chatelleraut, smashed up at the latter place when landing for petrol. All these flights, however, fell short of Vedrines' trip of 336 kiloms. from Poitiers to Paris in 3 hrs. 10 mins., and he therefore secures the first prize of £300.

Wynmalen in a Pond.

WHILE flying at Buc on Monday, Wynmalen had an unpleasant experience. After making a turn, at a height of 50 metres, the machine made a sudden dip, and, before the pilot could correct it, fell into a pond. This fortunately served to break the shock, and Wynmalen escaped with a ducking and some bad bruises, being rescued by a motor boat.

French Gordon-Bennett Eliminating Trials.

IT has now been decided that the French Gordon-Bennett Aviation Cup Eliminating Trials shall be held at the Rheims Aerodrome on June 10th and 11th.

Bouvier Has an Accident.

THE folly of the Tunisian crowd was the cause of an unfortunate accident to Bouvier on the 23rd ult. For three days he was detained at Sousse, and then determined to fly over to Sfax, where the French President was staying. He first flew over the town, and the news of his arrival quickly spread, causing a crowd to collect on the military parade ground, where the descent was to be made. Unfortunately the people were quite uncontrolled, and when within a few feet of the ground Bouvier found it would be impossible to land without injuring a good many who were scattered about the ground. He therefore determined to rise again, but failed to clear a tree, with the result that the machine toppled to the ground with a run. The aviator was picked up and carried to the hospital, and the latest reports say that he is making as good progress as can be expected.

Flying over Vienna.

LEAVING the flying ground at Weiner Neustadt, the Austrian aviator Bier piloted his machine over the Schœnbrunn, and then above the city, circling the tower of St. Etienne Cathedral, and finally landing close to Œynhausen. On the way to the city he passed over the troops which were being reviewed by the Archduke Francis Ferdinand.

Death of Colonel Schreck.

THE cause of aeronautics, especially in Switzerland, has suffered a grievous loss in the death of Col. Schreck, President of the Swiss Aero Club, which occurred at Berne on Tuesday last. Col Schreck, who was born in 1856, represented his native country in the last three contests for the Gordon-Bennett Balloon Cup, and it will be remembered that he was the winner in the competition for 1908.

A Belgian Military School.

ON Monday last a school for the instruction of military aviators was opened at Brasschaet by the Belgian Army authorities. Lieut. Nelis has been placed in charge, and the first pupils nominated by the Minister of War are Lieuts. Bronne, Dhanis, Sarseel and Tocy.

Fatal Accident to a Russian Aviator.

WHILE flying at Sebastopol on Monday on his Blériot monoplane, accompanied by a young brother, Captain Matsievitch, instructor of the Military Aviation School at Sebastopol, swooped down from a height of 25 metres, and striking a stone wall, the machine fell to the ground, both occupants being killed. On the previous Saturday Captain Matsievitch carried out some very fine flying over the fleet as it was leaving Sebastopol for the spring cruise.

Aero Club of America's New Home.

WITH the growth of the movement in the United States, the Aero Club of America has been casting about to find a suitable home, and has now decided to lease the mansion built by Colonel R. M. Thompson seven years ago. It cost about $200,000 to erect, and is finished both inside and out in the most luxurious style, among other items being bronze stairways, bronze and brass chandeliers, and stained glass windows. The rent is stated to be $5,000 a year.

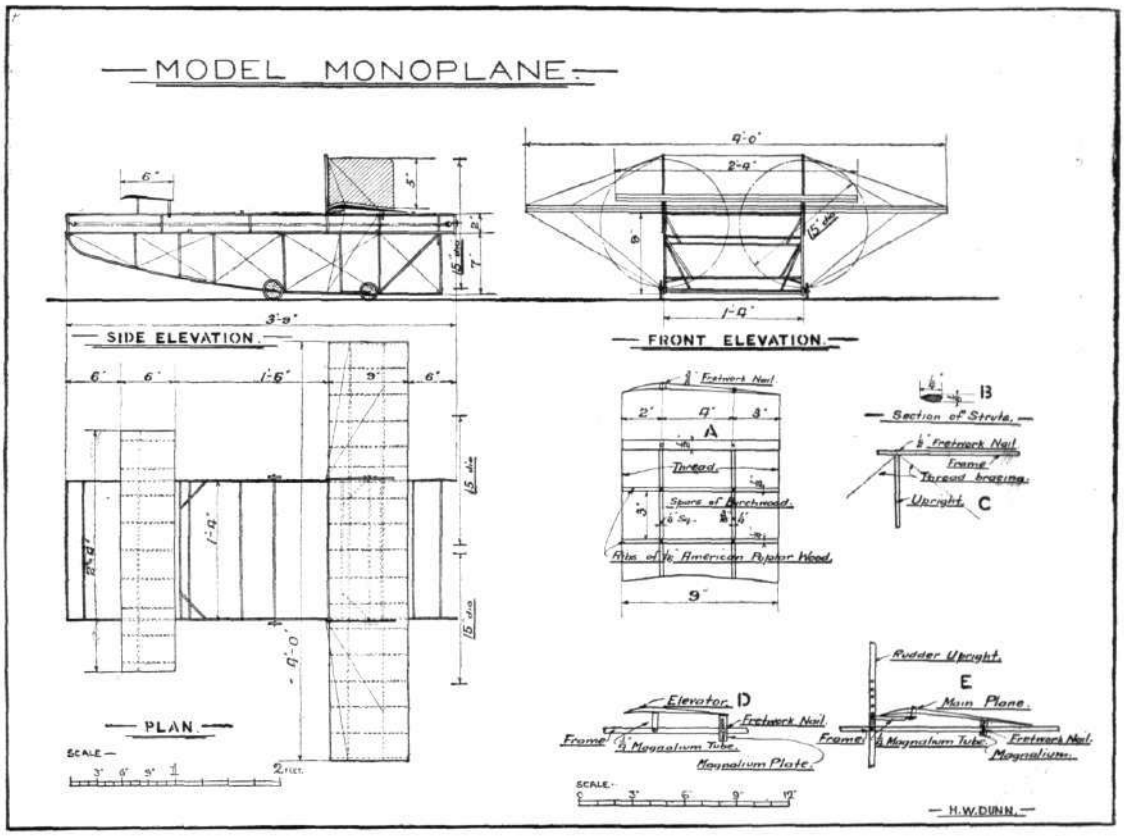
FLIGHT

A MODEL MONOPLANE.

By H. W. DUNN.

THE following is a description of a model monoplane that I have recently made, and as will be seen from the drawings, it is very much like the Valkyrie machine in general form, except that it has two propellers instead of one and that the rudders and elevator also differ. The main planes are made up of birch spars, the front spar being ¼ in. sq. section, and the rear one $\frac{5}{16}$ in. by ¼ in. in section. American poplar wood $\frac{1}{16}$ in. thick is used for the ribs, which are spaced 3 ins. apart, as at Fig. A on drawing; the angle of incidence may be adjusted as shown at Fig. E. I use the following method of fastening the fabric—which is mercerised lawn—to the planes:—Starting on the underside of the plane at the rear, I draw the fabric over the top side and then fasten it down at the place where it commenced; in this way a joint on the top of the plane is avoided. The fabric is glued to the ribs.

The skids and frame are made up of six spars, those at the top and bottom being of birch ¼ in. sq., whilst those beneath are of American poplar wood $\frac{5}{16}$ in. sq. Uprights, crossbars and stays are also of American poplar, made to the section shown at Fig. B; thread is used for bracing. The propellers are made of $\frac{1}{16}$ in. birch and steamed to correct angle; they are about 2 ins. wide by 15 ins. diameter. Ten yards of rubber, making eight strands to each propeller constitutes the power plant.



The method of fastening the uprights to the frame and also the bracing is shown in Fig. C, and at D is shown the elevator fitting. I obtained the wood from A. Melcombe, of Bedford, and the rubber from A. W. Gamage, of Holborn; mercerised lawn can be obtained from any draper's. I have had a great many flights from this model, and, of course, also many falls, but the skids have, so far, prevented the machine from smashing.

THE EUROPEAN CIRCUIT.

So far the entries for this event number seven, and include four British-built Bristol machines, these being the first four entries made, and three representatives of France are found in Morane monoplanes. The Bristol machines will include two monoplanes and two biplanes, and Tabuteau and Tetard are spoken of as likely to pilot the latter. The Morane machines will be handled by Vedrines, Frey and Gaget. It has now been decided that the "control" in England will be the Hendon Aviation Ground, which will afford Londoners a splendid opportunity of seeing the flyers, as they will be at Hendon for three days.

THE PARIS-MADRID RACE.

IT is announced that up to the present 20 entries have been received for the flight race being organised between Paris and Madrid. The entries include 4 Morane, 3 Blériot, 3 Nieuport, 3 Goupy, 2 R.E.P., 1 Tellier, 1 Barillon, 1 Train, and 2 machines which are not yet specified. So far the list of pilots nominated is very incomplete, but it includes the following names:—Vedrines (Morane), Bobba (Goupy), Divetain (Goupy), Prince de Nissole (Tellier), Amerigo (R.E.P.), Train, Barillon and Barra. The prizes will be: first, £4,000; second, £1,200; third, £600.

CORRESPONDENCE.

*** *The name and address of the writer (not necessarily for publication)* MUST *in all cases accompany letters intended for insertion, or containing queries.*

Correspondents communicating with regard to letters which they have read in FLIGHT, would much facilitate ready reference by quoting the number of each such letter.

NOTE.—*Owing to the great mass of valuable and interesting correspondence which we receive, immediate publication is impossible, but each letter will appear practically in sequence and at the earliest possible moment.*

The Elliott "Gyro" Compass.

[1160] Some interest having been expressed in the Gyro compass which we are fitting into numerous ships in the British Navy, a good many questions have reached us as to the suitability of the apparatus in its present form for aeroplanes.

We should like to point out that the Gyro compass as at present constructed is far too bulky and of too complex a nature to be used practically on any aeroplane, and, indeed, its employment would not be of any particular advantage to the aerial navigator as compared with a magnetic compass.

A magnetic compass properly adjusted and compensated so as to be unaffected by the iron and steel portions of the aeroplane, is a perfectly serviceable instrument, but in order that the compass may point in the direction of the magnetic pole and not at the engine, compensations are necessary which require the aeroplane to be "swung" in a manner similar to that employed in adjusting magnetic compasses on board ship. We understand that facilities for this process are in existence at Brooklands.

Precaution has also to be taken to prevent rapid vibrations set up by the engine affecting the actual compass card, and this we understand has been done in the case of a special form of magnetic compass which is being put upon the market by a well-known firm acting on some designs submitted to them by the best known experts on magnetic compasses.

36, Leicester Square, W.C. ELLIOTT BROTHERS.

A First Flight Experience.

1161] I enclose herewith three photos which may be of interest to yourself and to readers of FLIGHT. Some months ago you published a letter from myself *re* the possibility of passenger flights for say one guinea. While still believing that these will come to pass in the near future, I find that applications are treated with indifference at anything about that figure. At the present time and state of aviation I cannot, however, blame aviators in this matter. It is easy to take one's seat behind a skilful pilot on a well-tuned aeroplane and to smoothly fly and return to earth, and then wonder why the charges are seemingly high. But the enterprise, daring and patience to make this possible, can only, I take it, be really appreciated by those strenuously engaged in "the game." This by the way, however. I should like, with your permission, to give a brief account of how I took these photos. Through the courtesy of C. Compton Paterson, Esq., the Liverpool aviator, I got my long-tried-for flight, and it exceeded my expectations in many ways. I arrived at the Freshfield Aerodrome just after 2 p.m. on Saturday, 8th ult., and met the racing Farman just returning from a spin. The wind was rising and blowing strongly, but Mr. Paterson decided to take me up, and I was in the seat, the engine throbbed, and away we went along the broad smooth sands towards Southport, and took the air without knowing it. Now began the experiences of which I had no conception. The sands below and sandhills on our right, the sea away directly on our left, all sank below and *we stood still* seemingly, although the exhilarating rush of air said 50 m. p.h." For some miles we kept this course at about 300 feet up, then we turned to the left and swept out over the sea, heeling over as gracefully as a yacht. Here I took No. 1 photo, right over the pilot's head and beyond the elevator. You will notice the ribbed and coursed sands and the incoming tide. A long undulating course back beyond our starting point towards Liverpool found us at a height of 400 ft. We swept round again and passed directly over the line of the five large hangars. Here I took photo No. 2. This is a good gauge of our height. The blur, at the junction of the road and the beach, is a small crowd of spectators. We circled out to sea and dropped to about 200 ft. over the hangars again, to get photo No. 3 at closer range. Then up to 300 ft. and—silence and a steep dive, with the beach rushing up to us, as with the Gnome stopped we *vol planéd* to earth, landing, as we started, imperceptibly. Although there is nothing striking about these photos at first sight, yet when it is borne in mind that it was a misty, windy day, that I had never been aloft before, and yet was able to work the camera with both hands and yet feel quite secure, and that, travelling at this great speed over an exposed coast line, the well-defined image of the frame and elevator, and even the wires, makes the photos a striking testimony to the wonderful balance of the machine and the absolute control and skill of the aviator. I admired the ease and confidence with which Mr. Paterson fought the gusts and wind waves, and kept the aeroplane running smoothly. To my surprise, he was able to call out a running comment upon his moves for my benefit. The flight convinced me of the vast strides which aviation has made in little more than a year, and even if I cannot get aloft again the experience has added greatly to my already keen interest in aviation.

Flixton, near Manchester. PERCY A. AMOS.

Suggested Propeller Competition.

[1162] There are now a number of propeller manufacturers who all claim to obtain the best results. Some are alike, and some differ very much in size, shape, and thickness. The time is now ripe to wipe out many wild notions, and this can be best done by having one or more competitions, not only stationary tests but in actual flight.

Let a certain machine with a certain engine be chosen, let the makers send up their best efforts for this combination, and see which propellers give the best results stationary and in the air. To thrash the subject out thoroughly one would have to have different classes or sections, namely, the geared-down double propeller type, single ditto. But there are limitations to each of these, since most present day aero engines have not geared-down propeller-shafts.

We shall be very pleased to lend one of our Avro biplanes fitted with a 30-h.p. Green. It is usually driven at 1,100 r.p.m., and is 30-h.p. at that speed.

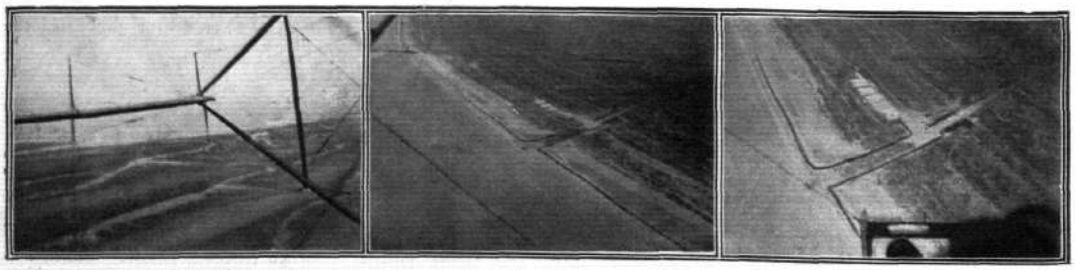
No doubt the Aeronautical Society, or representatives of the Royal Aero Club, could observe the trials, the results to be published in the aviation Press.

Brooklands. A. V. ROE.

"Is the Helicopter Possible?"

[1163] In answer to Mr. Weaver's letter (1140 in your issue of April 15th), I would ask Mr. Weaver to re-read my letter (1006 in your issue of January 7th) and also the extremely interesting one (1005 in the same issue) from Mr. J. R. Porter, when I think he will be led to modify his views.

Mr. Weaver takes me to task for supposing that any factor of safety at all should be considered in the construction of a flying machine; but the necessity of some factor of safety is evident unless the machines are to be death-traps, and this is admitted by Mr.



No. 1. No. 2. No. 3.

Mr. Amos' flight with Mr. Compton Paterson.

Weaver in his letter in spite of himself. For he there states that in a flying machine the factor of safety "has to be almost entirely disregarded," and then goes on to say that the fact that flying machines are thus constructed "is borne out, only too sadly, by most of the fatal accidents to aviators."

As a matter of fact, the importance of a factor of safety in the construction of flying machines is now being recognised, and the advances that have lately been made in these machines are solely due to truer mechanical construction and the allowance of a more or less reasonable factor of safety.

Mr. Weaver now proposes a helicopter type of machine of a total weight of 15 cwt., or 1,680 lbs. To be fitted with a 100-h.p. engine to drive a pair of helical (or lifting) screws 10 ft. in diameter, and also with a 50-h.p. engine to drive two screws 7 ft. in diameter (one as a tractor and the other as a propeller). The machine, in addition, to be provided with supporting planes (after the manner of an aeroplane) to have, as I take it, a total area of 25 ft. by 8 ft. = 200 sq. ft., and be provided with ailerons for steering purposes.

If we take out the various weights of the above we shall find that it is impossible to construct the machine within the limits of the total of 15 cwt. The 100-h.p. engine, at the low weight of 4 lbs. per horse-power, will weigh, without the radiator and connections, 400 lbs., and the 50-h.p. engine, on the same basis, 200 lbs., a total of 600 lbs. for the two engines alone. The radiators with their connections and necessary water, at a modest estimate, will weigh 50 lbs. Then there is the fuel and oil, if enough is carried for only one hour's consumption we shall require, at the rate of ½ lb. per horse power per hour, 75 lbs. of petrol, which with its container will weigh say 85 lbs., and allowing 5 lbs. for the lubricating oil and its container, makes a total for engines, radiators, fuel, water, oil and tanks of 740 lbs. The two helical screws, 10 ft. diameter, which have to transmit 50 horse power each and support the whole weight of the machine, will weigh, at a moderate estimate, with their shafts and spindles, thrust-blocks and bearings, 200 lbs. each, or 400 lbs. for the two, and the transmission gear from the engine to these screws, with attachments, would weigh at least another 50 lbs., making a total for the helical screws and all attachments and gears of 450 lbs. ; each of the 7 ft. screws, with their shafting, gearing, bearings and attachments, would weigh at least 40 lbs., or a total of 80 lbs. for the two.

The planes, at the low estimate of 1 lb. per square foot, will weigh 200 lbs., making a grand total up to now of 1,470 lbs., which deducted from 1,680 lbs. leaves a balance of 210 lbs. only out of which we have to construct the body of the machine capable of carrying all this and the weight of the driver as well, besides being strong enough to transmit the strains due to the exertion of 150-h.p. within it on a medium outside it ; which, to my mind, is impossible.

If Mr. Weaver can do this, both myself and others, I am sure, will be deeply interested to learn how it can be done, and to see the actual machine when it is made.

Maidenhead. CHARLES J. REYNOLDS.

Steering by Compass.

[1164] The article by R.A. on the above subject in your issue of April 22nd is of much interest in view of the present vogue for cross-country flights and the pending long-distance races, and you will perhaps pardon one who has spent the greater portion of his life "steering by compass" adding a few remarks on a subject which, I am glad to see, aviators who are undertaking cross-country flights are taking an increasing interest in ; in fact, some knowledge of the use of this instrument and its limitations is absolutely essential to any of them who aspire to get out of sight of their native aerodrome.

A series of articles on this subject by me were published in the *Aero* in February, in which I dealt with the subject of aerial navigation from a purely nautical standpoint, and special stress was naturally laid on the premier navigational instrument—the compass. With regard to this instrument, there is no difficulty whatever in providing a compass of a standard design which will fulfil all the necessary conditions when used in flight, on any type of machine, if the vibration is damped in the way advocated in my article, *i.e.*, the bowl placed in a receptacle packed with horsehair or other suitable material. This has been successfully tested on various types of machine—Blériot, Farman, &c.

There are, of course, numerous systems of taking up the vibrations on board ship which have been found effective to a greater or less degree on board vessels of every type, from battleships and ocean liners to turbine torpedo boats and trawlers ; but what is required for airwork is a simple system effective on any make of machine, and one in which gimballing to keep the bowl horizontal should be unnecessary, when used with a properly designed compass, and compasses which fulfil these conditions are now in use.

But, as was pointed out in the articles referred to, though a steady and well-designed compass is a *sine quâ non*, the instrument will be worse than useless unless designers of machines take an interest in the matter and provide a suitable position for it in the centre fore-and-aft axis of the machine, in a good magnetic position ; and also that the moving parts, such as steering pedestals, foot control, &c., be made of some non-magnetic material.

This detail is, I understand, being provided for in certain types, notably the later Howard Wright design.

Given a moderately satisfactory position, there is no greater trouble "adjusting" a compass in an aeroplane than there is on board a ship, and certainly far less than is the case in most ships, especially compasses placed in between-deck positions.

For the benefit of the uninitiated, I may say that the term "adjustment" means the elimination, as far as possible, of errors due to the unavoidable proximity of disturbing factors, such as the engine, stays, &c. The north point of the card is made to point as nearly as possible to the correct magnetic north when the machine is headed in any direction ; this can be done by the aid of small magnets suitably placed by one who is accustomed to the work.

R.A. does not consider that "leeway" is the proper term to apply to the deflection from the course due to the wind, and I think that from the ordinary definition of the term accepted by seamen this is not "leeway," and "drift" expresses what is meant far more satisfactorily.

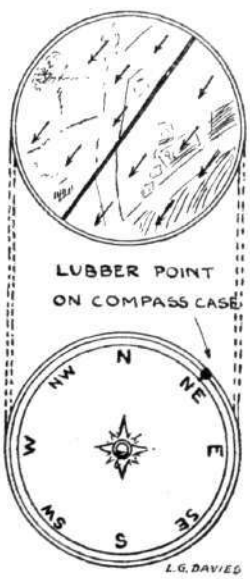
The question of providing some method of correcting the course for "drift" is one of peculiar interest to the aviator. For over-sea flights he is in much the same position as the navigator in a current, and must make his allowances and steer a steady course, trusting that his judgment is fairly correct, but for cross-country flights there is undoubtedly a field for experiment in R.A.'s observations, though I would suggest that, instead of introducing glass, talc, or similar materials into the construction of aeroplanes, the object would be achieved by providing a species of "grating" of light metal rods in the bottom of the machine ; these rods should be placed parallel to the fore and aft axis of the machine, between the aviator's legs, and in consequence would be in line with the "lubber line" of the compass. This would also have the advantage of allowing the pilot to get a better view of the ground, a point which certainly requires attention in some types of monoplanes.

With regard to R.A.'s last paragraph, it is hoped that a method of rapidly and economically arriving at the direction and speed of the wind at various heights at a given place without the aid of kites will be possible in the near future, should the trials now being carried out prove satisfactory.

It is to be hoped that the naval officers taking up aviation will especially study the navigational aspects of flying, for which their sea training should be of special value, and no doubt with their assistance the art of "aerial navigation" will make great strides as soon as they have got the aerial equivalent to "sea-legs."

Horsell. C. O.

[1165] May I thank your contributor, "R.A. (Retired)," for his remarks on my article, "Steering by Compass" (FLIGHT, September 24th, 1910).



Owing to an unfortunate mistake, the lubber-point was omitted altogether from my diagram, although it was mentioned in the text as being there. This lubber-mark on the compass-case, travelling round parallel with the line on the glass plate, corresponding to the adjustable arm, such as "R.A. (Retired)" suggests, the plate and compass-case being connected together in the manner described.

With regard to the relative resistance of aeroplanes and dirigibles, my contention only holds good, of course, in the case of gusty or puffy winds. A short gust striking an aeroplane and a dirigible at right angles to their course would have the effect of carrying the latter further to leeward than the former. The ratio of inertia of resistance of the aeroplane being greater than that of the dirigible, it would take longer to set the aeroplane drifting at the wind than the dirigible ; although in a steady side-wind they would, as your contributor states, both drift to leeward at exactly the same speed.

L. GRAHAM DAVIES.

Anerley.

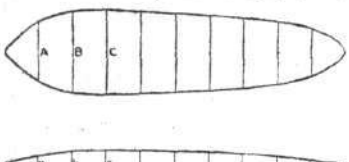
MODELS.

Model Dirigible.

[1166] Would you be so kind as to inform me how to cut and join the segments of a small dirigible, and oblige

Penge. "DIRIGIBLE."

[In the sketch suppose the upper drawing to be an elevation of the dirigible and the lower a plan of a segment. Then make the width of the segment at *a*, *b*, *c*, &c., equal to



3·15 times the diameter A, B, C, &c., divided by the number of segments desired. A slight allowance should be allotted at the edges for sewing.—ED.]

Paper Models.

[1167] I note that a reader, Mr. L. Baxter, has made an 8 in. paper model, self-propelled and carrying wheels, capable of flying 100 ft., the total weight of which is "about $\frac{1}{8}$ oz." I would be very interested if Mr. Baxter would weigh the model and let us know the exact result.

Personally I am inclined to lay considerable store by the use of paper models, as it seems that up to a certain point they contain the maximum of instruction with the minimum of time and expense in preparation.

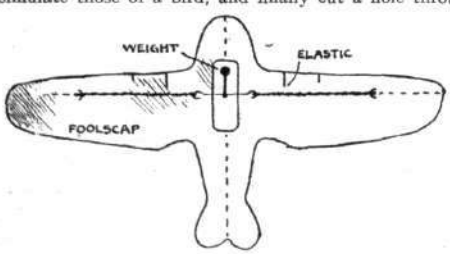
Some weeks ago a model of mine was published in these columns giving full details of its construction, of the materials used, of the exact weight and of the result in practice. The model, which was, I think, 10 ins. over all, weighed $\frac{1}{16}$ oz., and the distance flown by it 100 ft., but after the date that the actual model had been sent to the Editor a similar model flew over 200 ft.

I found that there was very little to be gained by reducing the weight further, as the model suffered proportionately in its alighting.

If Mr. Baxter or any other ingenious reader cares to develop the following idea he may find he is doing a service to the ornithopter school.

In considering the flight of a bird we speak of its "flapping its wings up and down," which idea we may equally correctly express by saying that, relatively to its wings, "it moves its body down and up," or in other words, that it keeps continually lowering and raising its centre of gravity relatively to its centre of pressure.

Now let us cut out a paper bird, reinforce the wings and body with small splinters of cane, shape and flex the wings to simulate those of a bird, and finally cut a hole through



the centre of the body. In this hole a small pendulum must be suspended capable not merely of swinging but of revolving over and over, above and below the bird's body, turning on an axis parallel to the length of the wings. (This can be effected with some strands of elastic suitably arranged.)

The effect, as we see at once, is to raise and lower the centre of gravity of the model relatively to the wings, with the result that when the model is allowed to glide through the air, the pendulum at the same time revolving, the wings flap with considerable naturalness and vigour. I cannot, however, report a sustained flight with one of these, but, as every model maker knows, it is unusual to be successful all at once, and now I have no opportunity to continue experiments.

In connection, however, with the above I made several paper models in which the wings were actually flapped relatively to the body by means of a light mechanism driven by elastic. These models gave far more satisfaction than the first, save for the greater difficulty in making them, and although I could never be certain as to what extent the flapping affected the glide of the model, I was satisfied that with perseverance a flapping flight would be quite practical.

If any of your readers know of any mechanical ornithopter that has achieved success I should be interested to hear of it.

Brentwood. GEO. C. SHERRIN.

PUBLICATIONS RECEIVED.

Record of Sports. Royal Insurance Co., Ltd., 1, North John Street, Liverpool.

The Aeroplane, Past, Present, and Future. By Claude Grahame-White and Harry Harper. London: T. Werner Laurie. Price 15s. net.

Catalogue.

Aeroplane Parts. A. Binet et Cie., Paris. Agents: The City Ignition Co., 274A, Goswell Road, E.C.

Aeronautical Patents Published.

Applied for in 1910.

Published May 4th, 1911.

6,287. H. J. HELLER. Aerial propeller.
9,047. L. WOLLMERSHAUSEK. Propulsion of aerial vessels.
9,485. PLANES, LTD., AND W. P. THOMPSON. Flying machines.
28,369. H. GAARA. Steering devices for aeroplanes.
30,209. E. RENAULT. Steering-gear for flying machines.

DIARY OF COMING EVENTS.

British General Events.

July 1 .. Gordon-Bennett Aviation Cup Contest.
July 22-Aug. 5 *Daily Mail* Round England Contest.
Oct. 31 .. Close of British Michelin Cup.

Foreign Fixtures.

May .. Paris—Bordeaux—Paris.
June 18 .. European Circuit—Paris, Brussels, London, Paris.
July .. Italian Circuit.
July 1-13 .. Circuit Berlin—Hanover—Hamburg.

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